POWER

Volume 60 New York, October 14, 1924 *No.* 16

Rensselaer

IT IS significant of the newness of the professional recognition of the engineer that the Rensselaer Polytechnic Institute, which celebrated last week the one-hundredth anniversary of its foundation, is the first school now in existence to be established in any English-speaking country primarily for the purpose of teaching science and engineering.

The idea behind this institution was the teaching of the application of science to the common purposes of life.

Not until 1835 did it become possible to obtain the degree of Civil Engineer, and that of Mechanical Engineer came many years afterward.

When Rensselaer was founded in 1824 the steam engine was feeling its way into general use. James Watt and Oliver Evans had been dead only five years and Fulton less than ten. Corliss did not patent his engine until twenty-five years later. Stephenson's successful trial of the Rocket did not come until five years afterward and it was a half dozen years before the first American steam railway was built. The first structural iron beam was not produced until after Rensselaer was a quarter of a century old.

It takes an event like its centenary to make us realize how recent modern conditions are, how short a time the world has been enjoying services and advantages without which it is difficult to see how we could carry on.

To the development of the century Rensselaer has contributed many leaders. Especially in the earlier days it furnished the engineering talent essential for the building of railways, canals, water works, and industries, and filled the professorships in the fast-growing number of educational institutions.

Its ideal has been realized. Science is no longer an abstraction. Its revelations applied to the common purposes of life, increase the yield of the soil, suppress or eradicate insect enemies, locate mineral deposits, mitigate disease, lengthen life, lighten labor, create new industries, make for convenience, comfort, culture and universal well-being.

Rensselaer has our hearty well wishes for a long life of continued honor and usefulness.

F. R. Low

Pulverized-Coal Boiler Performance, Brunot Island Power Station

By L. W. HELLER*

TWENTY-TWO months of operation of a pulverized-coal-fired boiler at the Brunot Island Power Station of the Duquesne Light Co. has shown that this method of burning Pittsburgh coal has several operating characteristics that are desirable and will be the dominating factors in the selection of furnace equipment in the future.

The desirable characteristics of this installation and the factors of extreme importance in the operation and design of the boiler plants are: (1) Comparatively high efficiency can be attained without the employment of highly skilled operators; (2) the equipment and method of combustion lends itself to automatic regulation; (3) absence of mechanical parts in the hot-zone of the furnace permits the unit to be operated for long periods of time without outage for repairs; (4) the boiler tubes are not subjected to an appreciable accumulation of slag or ash; (5) high evaporative capacities

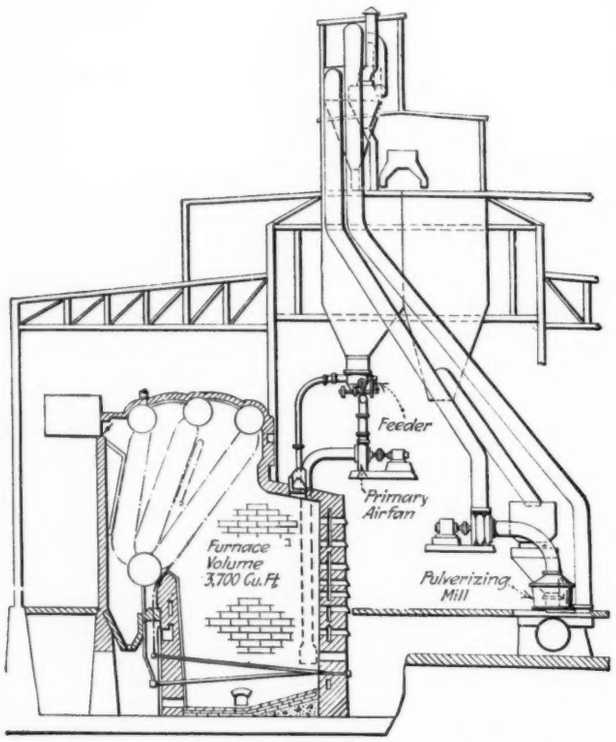


Fig. 1—General arrangement of installation

can be secured with low-draft loss through the boiler because of low-gas volumes per unit of fuel.

The unit was first placed in operation with pulverized coal in August, 1922, and has been in regular station operation since that time except when it was desirable to make physical changes of an experimental nature to the equipment or furnace.

The general arrangement of the installation is shown in Fig. 1. The firing equipment consists of a five-roll Raymond mill for pulverizing the coal, Lopulco feeders, burners and water screen. The boiler unit is a class M-30 Stirling, having 8,220 sq.ft. of heating surface; with the addition of water screens the surface was increased to 8,400 square feet.

As originally installed with stoker firing, a superheater of 255 sq.ft. was used. This same superheater

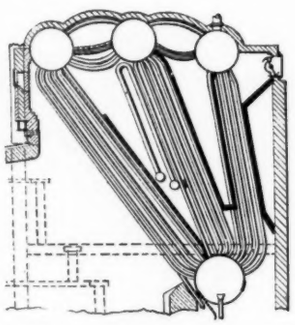


Fig. 2—Arrangement of three-pass baffle

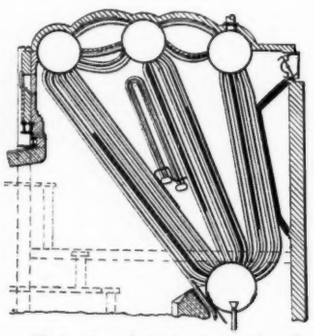


Fig. 3—Arrangement of four-pass baffle

was used for a time with pulverized-coal firing in order to secure comparative data on superheater performance with the two methods of combustion. After the original superheater had been in service a sufficient length of time to secure the data desired, it was replaced with a superheater of 1,031 sq.ft., in order to attain a higher degree of steam superheat.

Two types of baffle arrangement have been used, as shown in Figs. 2 and 3, the latter being in service at the present time. The furnace volume above the water screen is 3,700 cu.ft. No economizer surface is used, and air-preheating is limited to that done by the hollow walls of the furnace, through which all air for combustion passes.[1]

Compared with similar type boilers that are stoker fired, the unit has shown it can maintain higher efficiency without the close attention needed in the operation and maintenance of a stoker-fired unit.

The accompanying table gives the operating performance of the boiler unit for the period since it was placed in operation in 1922. During this period the unit has been operated in a regular manner by the station operating organization. At the same time sufficient data were secured by regular observations or recording instruments to indicate the performance without doubt.

All data given in the table are the averages for the individual months, the efficiency being the gross efficiency, no corrections or allowances being made for the power used for pulverization and feeding of the coal to the furnace. Comparison of the results obtained by the pulverized-coal method of firing and the stoker method has been made by the comparison of two units within the same station.

*General superintendent of power stations, Duquesne Light Company.

[1]See "Transactions of Engineers' Society of Western Pennsylvania" for October, 1923, for experimental data and details.

The stoker-fired unit is also a class M-30 Stirling boiler, equipped with a three-pass baffle of the same arrangement as that used with the pulverized coal, as shown in Fig. 2. The center line of the mud drum for the stoker-fired unit is 7½ ft. above the boiler-room

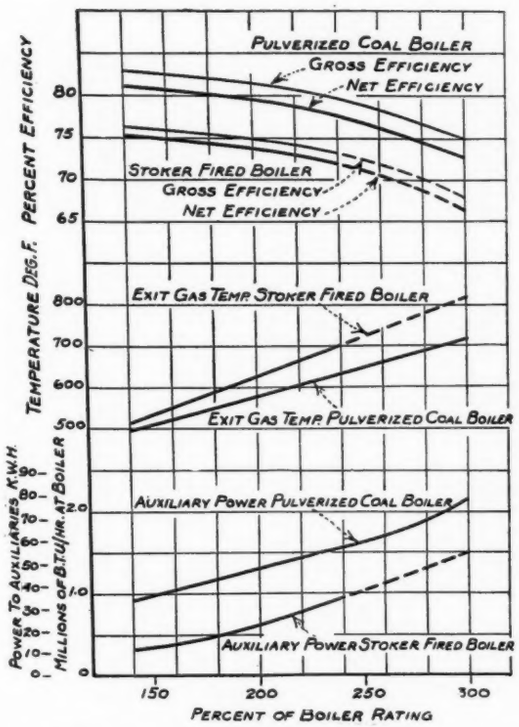

PULVERIZED COAL BOILER
GROSS EFFICIENCY
NET EFFICIENCY
STOKER FIRED BOILER
GROSS EFFICIENCY
NET EFFICIENCY
EXIT GAS TEMP. STOKER FIRED BOILER
EXIT GAS TEMP. PULVERIZED COAL BOILER
AUXILIARY POWER PULVERIZED COAL BOILER
AUXILIARY POWER STOKER FIRED BOILER
TEMPERATURE DEG. F. PERCENT EFFICIENCY
POWER TO AUXILIARIES, K.W.H. MILLIONS OF B.T.U./HR. AT BOILER
PERCENT OF BOILER RATING

Fig. 4—Comparative performance of pulverized-coal- and stoker-fired boilers

Each boiler equipped with three-pass baffle shown in Fig. 2.

floor, and the furnace volume is 2,100 cu.ft. The mud drum of the pulverized-coal-fired unit is 5 ft. above the boiler-room floor.

The comparisons shown graphically in Fig. 4 are made from carefully performed tests on each type of boiler, covering a range of from 150 to 300 per cent of rating with the pulverized-coal boiler, while data were secured for a maximum of 240 per cent of rating with the stoker installation. Greater spread of results will no doubt exist in daily operation, because of the inability to keep the stoker-fired unit as close to test performance as can be secured with the use of pulverized fuel.

OPERATING PERFORMANCE OF PULVERIZED-COAL BOILER

Date	Average Boiler Rating Per Cent	Average Exit Gas Temperature, Deg. F.	Average Efficiency Per Cent
1922			
September	171	573	79.2
October	135	586	77.2
November	139	577	78.4
December	181	583	77.2
1923			
January	196	600	77.2
February	192	590	78.6
March	201	604	78.7
April *	170	522	79.0
May	157	501	81.1
June	162	501	80.7
July	162	503	81.7
August	153	509	80.9
September	164	515	80.0
October	180	527	80.7
November	180	531	79.9
December	160	524	81.8
1924			
January	174	514	80.9
February	170	516	79.6
March	170	517	77.4
April	168	496	80.8
May	184	512	80.1
June	182	510	80.1

*Baffle changed from three-pass to four-pass.

The power consumed by the boiler auxiliaries is given in each case in terms of kilowatt-hours as well as millions of B.t.u. per hour at the boiler based on the station heat rate. Based on these results secured in the same station with similar coal, the pulverized-coal unit shows a net efficiency six points higher than that of the stoker-fired unit, between the ratings of 150 and 240 per cent. It must be borne in mind that these comparisons and results are based upon performance with a three-pass baffle arrangement as shown in Fig. 2 and not with the type shown in Fig. 3, which is the arrangement now in service.

The auxiliary power requirement of the unit with a four-pass baffle will be slightly less for a specific rating than the amount indicated in the curves for three-pass operation.

Because of the nature of the combustion of coal when in a pulverized form in a furnace, the lack of an appreciable heat storage in the furnace and the ease of controller of the feed of both the fuel and the air, the burning of pulverized coal lends itself well to automatic control.

Fig. 5 shows the instrument and control board of this unit, which has been operated under automatic control for the major part of the period since May, 1923. Hand control of the stack damper, fuel feed, etc., is used only at such times as it is desirable to operate

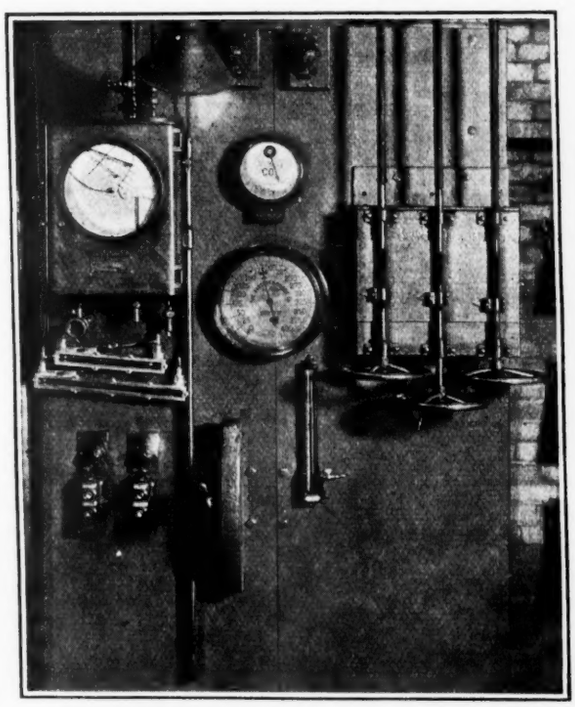


Fig. 5—Instrument and control board of pulverized-coal boiler

the unit at constant output regardless of the plant steam pressure and at such times as during the process of ash removal from the bottom of the furnace and the soot blowing of tubes.

As the rating and heat liberation in the furnace is increased, there is a tendency for the furnace temperature to rise to a point where the ash will melt and run down the side walls. The melting of the ash on the

side walls, although not serious, is undesirable. The combustion control in use is of such a type that it is possible to vary the process of combustion at different ratings, securing a low ratio of excess air at the lower ratings where the heat liberation in the furnace is low, and increasing the ratio of the excess air at the higher

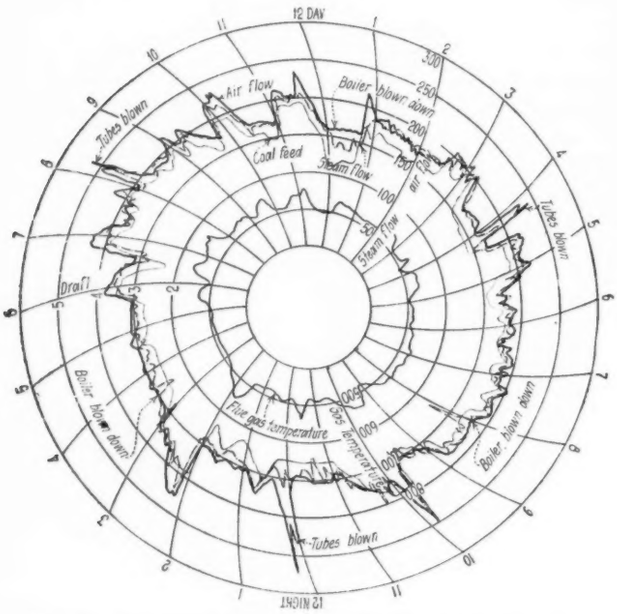


Fig. 6—Typical boiler-meter chart with automatic boiler control

Total steam 1,068,000 lb.; steam per hour, 44,500 lb.; average boiler rating, 175 per cent; CO_2, 14.5 per cent; exit-gas temperature, 511 deg. F.; hours of service since last cleaning, 778.

ratings where the heat liberation is more intense. This adjustment of excess air with rating allows the maintenance of a more uniform furnace temperature.

On this unit as now operating with the four-pass baffle, which gives a much hotter furnace than the three-pass baffle, the excess air is maintained at approxi-

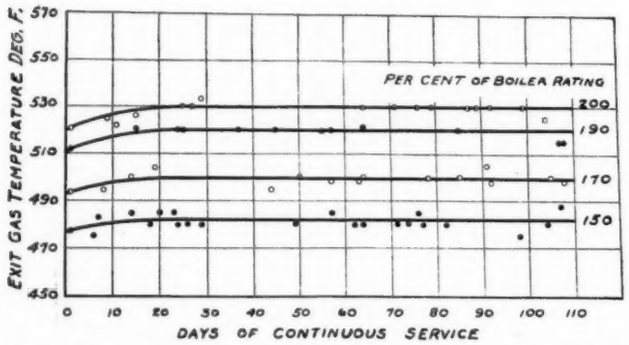


Fig. 7—Variation of exit-gas temperature with days of continuous service

mately 20 per cent at 150 per cent of boiler rating and increased to approximately 30 per cent at 250 per cent of rating.

It is equally important in automatic control that there be no appreciable time lag and that the unit handle fluctuations in load, which are generally evidenced by variation of plant steam pressure. The boiler operates with variation of load from 150 per cent to the maximum rating obtainable with the draft available, which is about 250 per cent.

Fig. 6 is a reproduction of a chart recording the main variables for Jan. 26, 1924. This chart is typical of the results being obtained with automatic control.

The absence of mechanical parts in the hot zones of the furnace makes it possible to operate the boiler for longer periods of time than is possible with stoker-fired units, which usually require the replacement of castings in a much shorter time if operated at a comparable rating. Further development of refractories and methods of installation will no doubt make it possible to still further lengthen the periods of continuous operation of pulverized-coal-fired boilers.

The limited accumulation of slag and ash given as the fourth characteristic is of equal importance with the absence of mechanical parts in securing long periods of service at reasonable economy.

The tubes of this boiler are not subjected to the

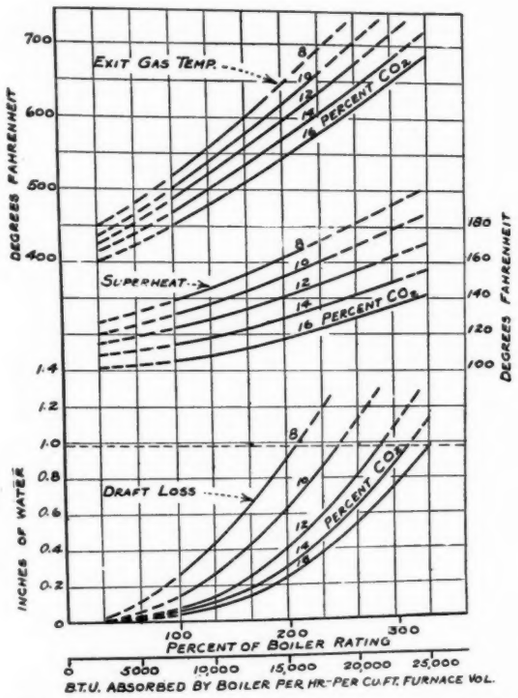


Fig. 8—Performance with three-pass baffle

same accumulation of slag, ash and soot that occurs with a stoker-fired furnace. A slight coating of fine ash or dust apparently settles on the tubes, but regular operation of soot blowers maintains the tubes so clean that the efficiency of the boiler is not materially affected by continuous operation for a long period.

The results can best be indicated by reference to Fig. 7, which gives the exit-gas temperature at various ratings on a continuous service run of 110 days. The excess air for a specific rating was practically constant through the run, so that this variable, which would have the most effect on the exit temperature, can be eliminated from consideration.

During the period at the start of the run, immediately after the boiler has been out of service and has been thoroughly cleaned, the exit temperature rises regardless of tube blowing and apparently reaches a stable condition after approximately 25 days of service.

From this point on the exit temperature becomes

practically constant for a given rating if tube blowing at intervals of eight hours is maintained. No data are as yet available on exit-temperature characteristics when the boiler tubes are blown at a different interval of time.

The ability to keep the heat-absorbing surfaces of the boiler furnace free from a material accumulation of insulating ash and slag is of considerable value, and this one factor becomes of importance as savings can be made in boiler-plant operation by reducing, in number,

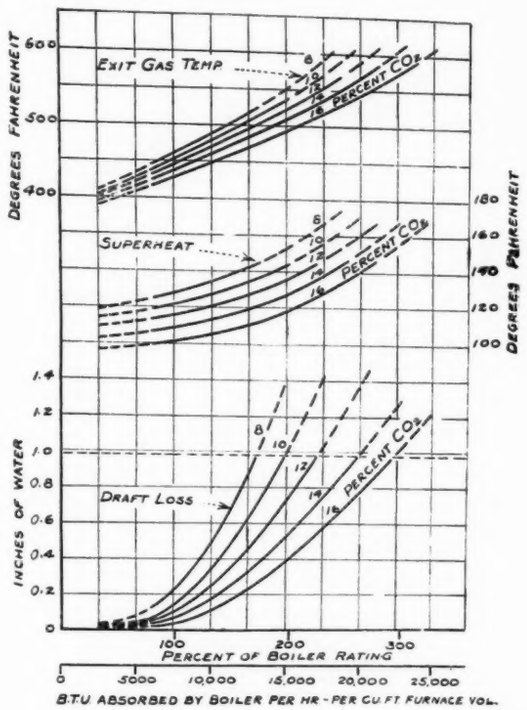


Fig. 9—Performance with four-pass baffle

the outages necessary for cleaning. An improvement in the availability factor of boiler units is needed, and operation over longer periods of time appears to be the solution.

With pulverized coal it is possible to control the proportion of fuel and air and thereby secure the excess air or CO_2 desired. This ability to secure a low excess air materially reduces the draft loss through the boiler.

With the three-pass baffle boiler a rating of 330 per cent was obtained with an available draft at the damper of 0.98 in. of water, while with the four-pass baffle arrangement the rating was limited to 290 per cent, both based on 16 per cent CO_2.

Figs. 8 and 9 show the effect of variation of CO_2 on draft loss through the boiler, as well as the effect on the superheat. These results were obtained by test, the excess air being regulated to the desired amount.

The destruction of a $100,000 dam to determine what factor of safety actually exists in the arch dam, used for centuries in impounding water, is contemplated by an experiment for which preparations are being made by the Engineering Foundation, in co-operation with governmental, educational and private organizations. The arch dam is to be built in a canyon in a tributary of the San Joaquin River, in Southern California. The first height of the dam will be 60 ft.

Temperatures in Water-Tube Boilers

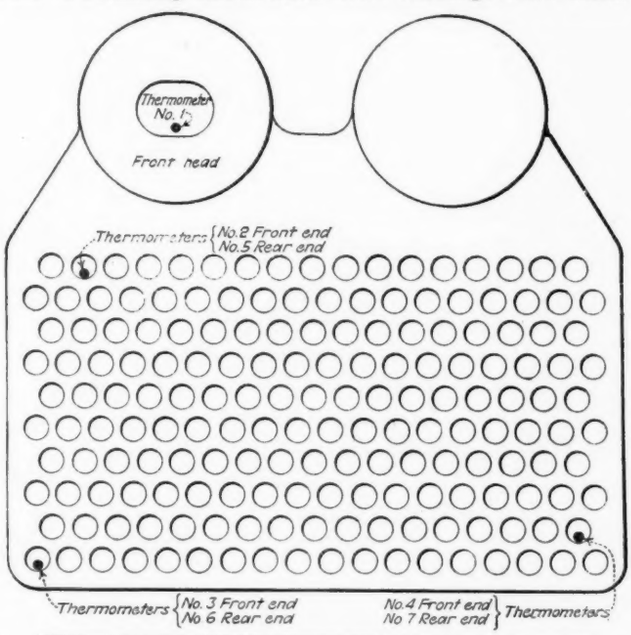
Investigations at Rensselaer Show Little Variation Throughout Boiler

There is a prevailing belief among engineers that there is a considerable difference between the steam and water temperatures in different parts of a boiler. Those who have watched the rapid ebullition going on in a boiler and the velocity of the water as it passes along the tubes and up the headers, feel that there must be a considerable pressure difference between the top and the bottom of the headers of a water-tube boiler to account for this difference. In addition it would seem that on account of the head of water, the pressure at the bottom would be enough greater than at the top to cause a marked variation in the temperature.

Since no data dealing with this question seemed to be available, experiments were conducted at Rensselaer Polytechnic Institute, under the supervision of Prof. E. A. Fessenden. The boiler tested was a Keeler water-tube having 175 tubes, 4 in. in diameter by 18 ft. in length.

The caps of certain tubes, indicated in the illustration, were fitted with hollow tubes extending into the headers. As example, at the lower left-hand corner of the boiler No. 3 thermometer was inserted in the front header and No. 6 in the rear header.

The boiler was carrying a constant load and was hand-fired. To simulate various load conditions, the fire was increased long enough to cause a rise in the rate of steaming and at such times readings were taken


Thermometer No. 1
Front head
Thermometers No. 2 Front end No. 5 Rear end
Thermometers No. 3 Front end No. 6 Rear end
No. 4 Front end No. 7 Rear end Thermometers

Thermometers		1	2	3	4	5	6	7
Test	1	322	322	322	325	324	324	324
	2	322	323	327	324	322	324	325
	3	333	335	337	340	334	335	335

All readings taken simultaneously within 10 seconds

Location of thermometers in boiler

simultaneously by observers stationed at the several stations. Three of such tests were run, as indicated in the chart below the illustration. It will be noticed that the variation in temperature in the boiler at any given time was practically nil; the maximum variation, which occurred during test 3, was 7 deg.

Getting the Most Out of Waste Steam

By Charles P. Putnam*

It is doubtful if there is greater opportunity for saving fuel than in the proper application of heat in the industrial process, particularly when steam is the medium used. In the last few years there has been a general application of mechanical stokers or pulverized fuel to boilers, with an increase of combustion efficiency from 65 to 75 per cent over-all. This represents a fuel saving of 15 per cent on the average. With the most probable improvements in boiler practice it is scarcely possible that a gain of much more than another 15 per cent will be made. For large future economies it is therefore essential that possible savings be looked for beyond the boiler room, in the industrial plant itself.

Leaks in the Plant

It has long been recognized that leaking valves and traps, uninsulated pipes and wasted exhaust are sources of greater loss than that due to inefficient firing. In spite of this, valves and traps still leak and exposed pipes still abound.

However, the tremendous field of waste-heat utilization in process work is almost untouched, although the opportunities for savings are unbelievable. Lack of co-ordination between various parts of the plants and disregard of relative conditions in the design of heat-using apparatus are responsible.

In most manufacturing plants the cry for greater production has caused the speeding up of machinery with attendant increases in power and steam consumption far in excess of the requirements of properly designed equipment for this service. As far as heat economy and regulation are concerned, most of this machinery is carelessly designed in the first place, and its relation to other parts of the process which could supply waste heat is absolutely disregarded.

Power generation forms one of the most attractive sources of waste heat in the form of exhaust steam, yet a pitifully small use is made of this compared to that possible. To show the economy of this type of system, the thermal units required to generate a kilowatt-hour may be compared as follows: Industrial plant, 30,000; central station, 20,000; mercury turbine, 10,000; byproduct power, 5,000; perfect (100 per cent efficiency) engine, 3,412. As yet the mercury turbine is not a commercial proposition, but it is hailed as a tremendous advance in economy.

Using the Exhaust Heat

The byproduct machine is little known, and less understood, outside of a few industries where it has been used for years with success, giving an economy four times as great as the great central stations. Its limited application has been due to prejudice and lack of knowledge of the requirements and advantages in the use of low pressures in heat application to processes. It is a common fallacy to believe that speed requires high temperatures and pressures and that exhaust steam is not as hot as boiler steam at the same pressure. Improper regulation and too small supply and return piping is more often the source of trouble than pressure. High exhaust pressures are perfectly feasible and economical, but in most cases 10 lb. will work as well as 50 lb. per sq.in. pressure provided the apparatus is correctly designed. It is to be noted also that an engine or turbine designed to operate on 10 lb. back pressure works just as well on 50 lb. back pressure, yet hundreds of installations have been abandoned or not extended owing to the idea that high back pressures were not possible.

To show how little the advantage of using exhaust steam at any pressure is understood, a recent authority, pleading for more thought in the design of the industrial plant, states that it is preferable not to connect the power plant in any way with the industry since condensing turbines now generate power cheaper than non-condensing plants where the exhaust is used. How many plants fail to secure maximum results through just such lack of co-ordination of the parts as suggested! A specialist in manufacturing relations who can look at the plant as a whole and not at the individual unit, is sorely needed.

In addition to the method suggested of saving fuel, there are numerous other ways available, such as the storage of heat in water, as yet scarcely touched; the recirculation of hot gases, and the use of other media than steam.

Greatest Saving in Processes

The manufacturer who builds his plant today without a careful survey of the entire situation may miss great operating economies, and he who installs new equipment in an old plant would do well to investigate carefully before he selects the most modern equipment, since it may involve additional changes beyond its advantages. Even the latest designs of equipment are often crude in many respects and uneconomical in the use of power and steam. Power may cost but 2 cents per kilowatt-hour and steam 70 cents per 1,000 lb., but an increase beyond plant capacity may involve tremendous expense to get the additional requirement.

Nowadays great attention is paid to the economical generation of steam and power, but very little to its use after it leaves the power station. Few plants know the minimum requirements of their processes as they do the guaranteed steam rates of the turbines. In the latter 5 or 10 per cent improvement is earnestly sought and hard to get, while 20 or 30 per cent over the former is neglected and uninteresting simply because the minimum is unknown, and therefore the executive is helpless to keep his plant at maximum efficiency.

No one need expect to produce marvelous results in savings in a week or month, but a careful analysis of the uses of heat in any plant almost invariably returns its cost many times in a year.

To leave the boilers and turbines alone from now on, and look to the plant itself, should be the aim of every manufacturer whether he makes or uses equipment.

Condenser tubes can be cleaned by the following methods: (1) Forcing rubber plugs through them by water or air pressure; (2) scrubbing with wire brushes; (3) baking with steam in the steam space, thus loosening the dirt, which can then later be washed away; (4) sandblasting process by utilizing sand or ashes shot through with an ejector, employing water; (5) soaking the water spaces with a mild acid solution, and (6) washing with high water pressure.

*Associated with John A. Stevens, Engineer, Lowell, Mass.

Turbine Packing, Bleeding Arrangements and Other Features of Westport Station Addition

ORIGINAL ideas of the engineering and operating force, together with an investigation of latest developments in central-station practice has led to the design of a special type of high-pressure packing gland, the use of vertical hairpin tube heaters with special check valves and direct-current ball-bearing electrical auxiliaries.

IN ORDER to provide generating equipment to meet the demands of the 1924 season, especially during the period of minimum flow at the main hydro-electric generating station, two 20,000-kw. turbo-generators were ordered from the General Electric Company, to replace four engine-driven 2,000-kw. generators that had been installed in 1904 and 1905. Many special features incorporated in the new installation were described by A. L. Penniman, Jr., before the Baltimore section of the A. S. M. E. on May 6, 1924. Since it was necessary for these units to operate at 62½ cycles, the rated speed of 1,800 r.p.m. was raised to 1,875 r.p.m. These were nine-stage units connected to 25,000-kva. generators, supplied with steam at 200 lb. absolute, total temperature originally of 500 deg. F. As there was sufficient boiler capacity already installed, it was decided to raise the steam temperature somewhat above that ordinarily generated, for which radiant-type superheaters were added. The turbines therefore were required to be suitable for 700-deg. steam.

It has been difficult to prevent the leakage of steam from the high-pressure shaft packing of the large impulse turbines into the room. This steam is annoying, particularly in cold weather, as it immediately condenses upon coming in contact with the roof of the building or any other cold surface, and rains down

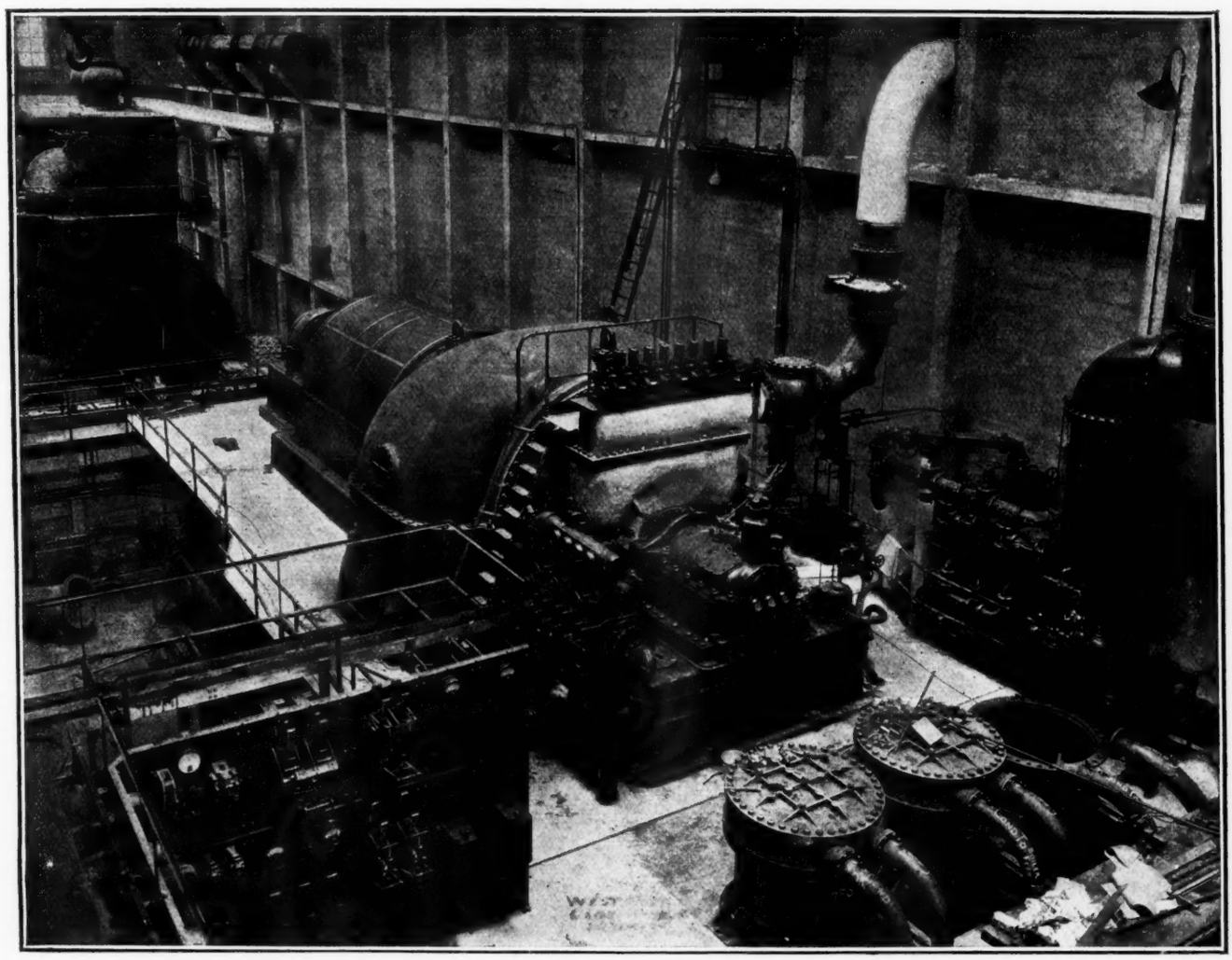


Fig. 1—Two-stage jet air pump shown to right of turbine ladder. Hairpin tube heaters may be seen in the foreground

on the turbine and other apparatus. It was contemplated that this condition might be avoided by the installation of a water-seal packing outside of the labyrinth packing regularly used, arrangements being made to bleed off any steam that might leak through the labyrinth packing to one of the stage heaters. As this steam would be highly superheated, it was essential that the water-seal packing be so designed that sufficient water might be circulated through the packing casing to prevent the possibility of the casing becoming steambound. This arrangement, if workable, would also lower the temperature of the outboard turbine bearing by eliminating the transfer of heat from the packing to the bearing journal shaft, thereby prolonging the life of the bearing lubricating oil. Accordingly, the contract with the turbine manufacturer specified the installation of a water-seal packing as in Fig. 2.

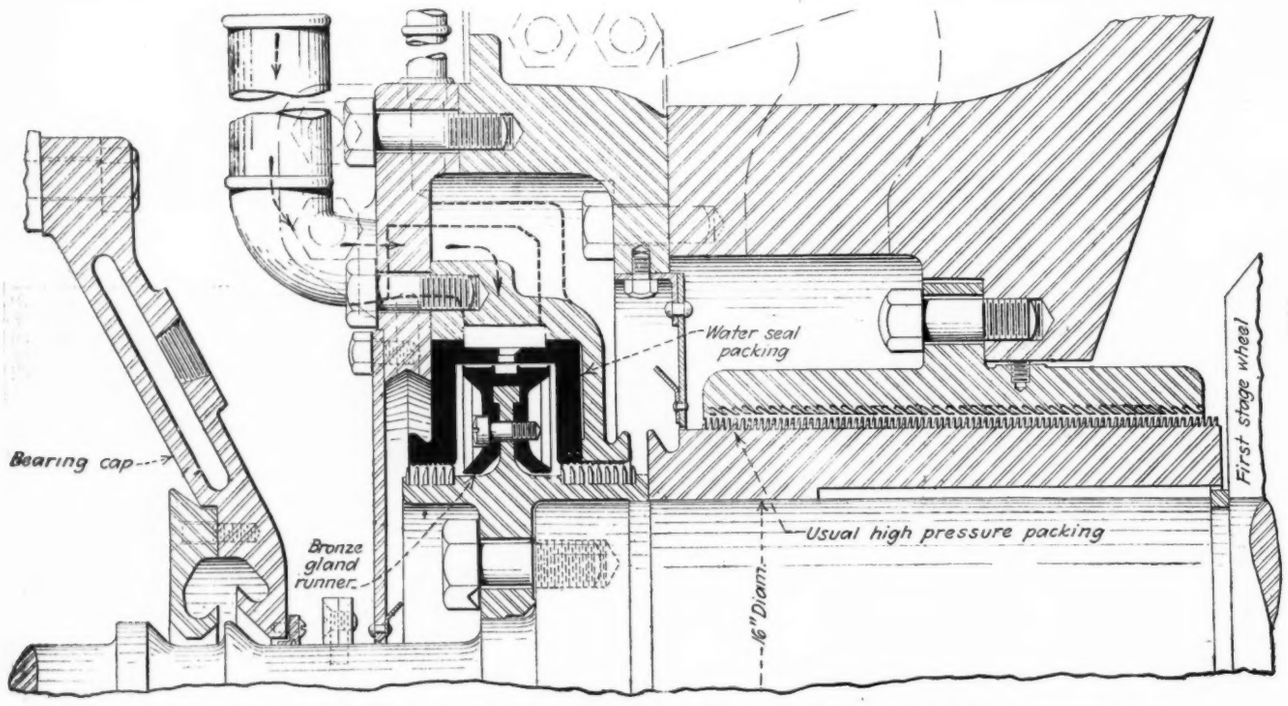


Fig. 2—Water seal added to regular high-pressure labyrinth gland

The closed system of ventilation for turbo-generators with the use of surface-type coolers was considered desirable. This obviated the possibility of the generator becoming fouled with dirt, greatly reduced the fire hazard by the exclusion of all but a small amount of oxygen from the generators, and provided for the recovery of a relatively small amount of heat by circulating condensate through a part, at least, of the cooling surface. The use of condensate also tended to insure clean tubes, thereby avoiding frequent cleaning of their inside surfaces.

During the summer and early fall, when the circulating-water temperatures are relatively high, the vacuum on the main condenser drops to such a point as to prevent the possibility of the condensate sufficiently reducing the temperature of the air from the generator. For this reason an auxiliary set of generator air coolers is provided which may be supplied with service water in sufficient quantities to maintain the proper temperature of the generator windings. This water is taken from the main house service supply system, passed through a booster pump, the auxiliary oil cooler and auxiliary generator air cooler, after which a sufficient amount to provide the necessary makeup is admitted to the main condenser, the remainder being discharged through spray heads to reduce its temperature and then returned to the service system.

The greater economy and freedom from moving parts of the two-stage steam-jet type of air pump, fitted with surface-type inter- and after-condensers, together with its somewhat lower first cost and apparently greater reliability, seemed to warrant its use. To make this pump readily accessible for adjustment, due to variation in quantity of air handled, and to preclude any possibility of the inter-condenser becoming flooded, it was decided that the air pump should be placed on the base of the turbine adjacent to the outboard steam end as in Fig. 1.

The economical advantage of bleeding steam from the main unit to heat the condensate before it was returned to the boiler, according to the calculations, warranted the installation of three bleeder heaters to bleed steam from the main turbine at the seventh, fifth and third stages, at which points the pressure at full load would be approximately 6, 20 and 54 lb. abs., which would give feed-water temperatures, leaving the several heaters, of 165, 222 and 281 deg. F. respectively.

Owing to the fact that the steam exhausted from the second-stage nozzle of the steam-jet air pump would have a temperature in excess of 212 deg., or some 50 deg. higher than the temperature of the water leaving the seventh stage heater, it was decided to install the after-condenser of the steam-jet air pump so that the main condensate would pass through the water side of this condenser after leaving the seventh stage heater and before entering the fifth stage heater. The only other exhaust steam that had to be taken care of was

from the auxiliary oil pump, so that the after-condenser mentioned was provided with sufficient surface to care for this rather small additional amount of steam.

Inasmuch as the temperature of the water leaving the fifth stage heater was somewhat in excess of the boiling point at atmospheric pressure, it was felt advisable to locate the boiler-feed pump so that water leaving the fifth stage heater would enter on the suction side of the pump. The discharge into the third stage heater would, therefore, be under boiler pressure.

As the steam spaces of the bleeder heaters were connected to the turbine at the several stages, it was essential that provision be made to prevent water, if discharged into the steam space on account of a leaky heater tube, from getting back into the turbine, which it would undoubtedly tend to do, particularly at periods of light load. It was also desirable that any form of check valve used have a minimum pressure drop, particularly for the seventh stage heater where the valve was rather large (14 in. nominal diameter) and the pressure relatively low, being less than 6 lb. abs. at full load. For these reasons bleeder check valves were specially designed, which were effectively arranged to prevent hammering due to fluctuations in load, but which would seat positively. The moving parts were built of a special aluminum alloy, thereby decreasing the weight and greatly reducing the drop in steam pressure across the valves.

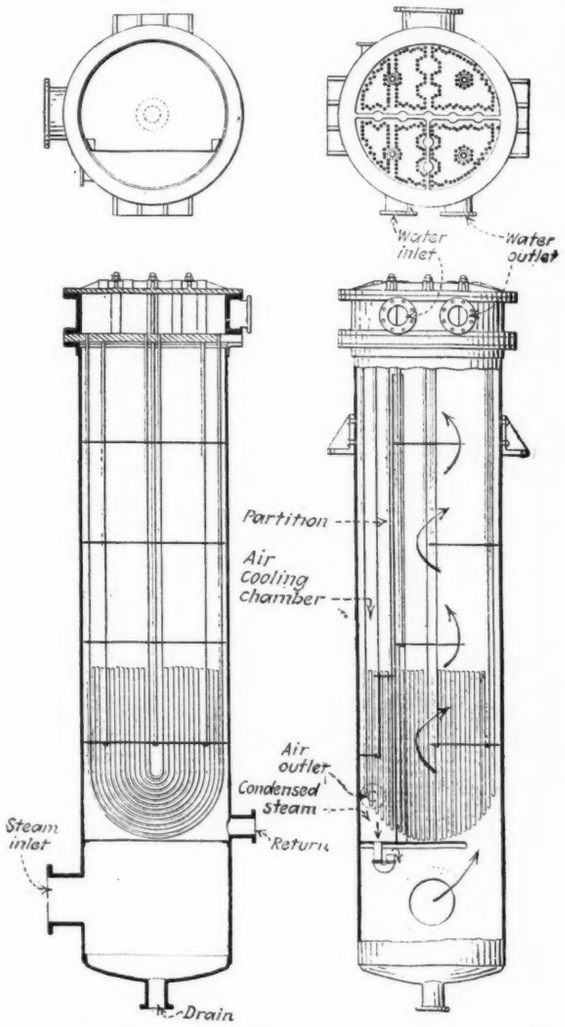


Fig. 3—Hairpin tube heater utilizes air-cooling chamber for chilling non-condensable vapors

In looking over the available closed heaters which were on the market it was found that they were, with but one exception, built with straight tubes and floating heads, to take care of expansion, and designed to be installed in a horizontal position. One heater manufacturer was found who was building some closed heaters for similar service with the tubes in the shape of hairpin loops, which provided for free expansion of the tubes. These heaters, however, were to be put in a horizontal position, thereby making the dismantling and assembling of the tube banks very difficult; they also occupied a great deal of space.

This type of heater, with a steel shell and all joints riveted and welded, was placed in an upright position so that the water-box heads and tube bundles could be readily dismantled by the use of the crane. The three heaters on each machine are interchangeable so far as the shells are concerned, with the exception of the size of the steam-inlet connections. The tube bundles are all identical and interchangeable. They contain approximately 2,000 sq.ft. of surface made up of $\frac{3}{4}$-in. 16-gage tubes, expanded into $2\frac{1}{2}$-in. thick steel tube sheets. They are all arranged for 4-pass operation as in Fig. 3. The water-boxes and covers are identical, with the exception of the fact that the water-boxes and covers for the third-stage heaters, which are under boiler-feed pressure, are made of steel and are provided with some additional staybolts, whereas the boxes and covers for the fifth- and seventh-stage heaters are made of cast iron.

Air Cooling Compartment

About 20 per cent of the surface is protected by a baffle built integral with the heater shell. A part of the incoming water is passed through this surface, which chills the non-condensable vapors in exactly the same manner as the cold surface under the air baffle of ordinary surface condensers. Any steam that may be condensed on the air side of this baffle is trapped back to the main steam space.

A condenser shell somewhat larger than normal was utilized, so that it was possible to provide ample steam lanes. Ordinarily, there is little or no rise in temperature of the water that passes through the tubes used for cooling the non-condensable vapor, on its way to the vacuum pump. In this condenser the water thus used in the first pass was directed by a special baffle plate so as to enter through the upper tubes of the second pass, where the highest steam velocity is encountered and where maximum work may thus be done.

A means of deaërating feed water and also a storage for the condensate was arranged by providing a specially large hotwell for each condenser. Since storage space for boiler-feed water is necessary at some point, each hotwell was given a capacity of 3,000 gal. The return condensate from the feed-water heater shells is fed into the hotwell at such a temperature as to keep the water boiling sufficiently to remove any entrained air or non-condensable gases. This eliminated the expense of special deaërating apparatus, with the attendant degradation of heat head for the water being deaërated.

The bled steam condensed in the third-stage heater shell is trapped back to the fifth-stage heater, where part of it flashes into steam and is recondensed. This,

together with the condensed steam bled to the fifth-stage heater, is trapped to the seventh-stage heater, the condensed steam from all of the heater shells being trapped to the 3,000-gal. hotwell. Valve-stem and pump-packing glands below atmospheric pressure were protected against air leaks by special water stuffing boxes kept under positive pressure. Special traps were utilized which contained no external glands, the mechanism being internal.

An auxiliary direct-current generator, flexibly connected to the main unit, driving direct-current auxiliaries as utilized on these units, is described in the April 8, 1924, issue. Speed variation is easily obtained with direct-current units, and the 40 per cent range for the circulating pumps is handled by means of hand-operated controllers, and a 25 per cent variation for the boiler-feed pump is maintained by automatic regulators. These latter hold a constant pressure drop across the control valves of the Copes feed-water regulators which admit water to the boiler. All motors are brought to speed by automatically accelerating contactor equipment.

Oiled Sleeve Bearings Principal Cause of Trouble

An analysis of the cost of maintaining motors for auxiliary drives, of which there were already about 5,000 rated hp. indicated plainly that 80 per cent of the total money expended for motor maintenance was chargeable either directly or indirectly to the oil-lubricated sleeve bearings. These troubles were largely due either to oil being drawn out of the bearings by the ventilating fans and deposited on the motor windings, ultimately ruining the insulation, or the bearings themselves failing due to lack of oil, dirt or the oil rings refusing to turn. In order to eliminate these troubles, ball bearings were installed throughout. The circulating pumps were equipped with roller bearings.

Since each turbine displaced two engine-driven sets, it was necessary to remove four of these engine units. Dismantling the first unit was begun on June 1, 1923, by a contractor and completed Aug. 15, representing 2½ months. The three remaining units, however, were dismantled by the structural-iron workers of the operating company, who completed the dismantling of the three remaining units by the 13th of October, which was a little less than two months after beginning. At no time had there been more than six men working on the job. The engines were broken up for scrap, the larger castings being reduced to such sizes as to be readily handled by means of a 3,000-lb. ball dropped 50 ft. from a crane. In all 1,830 tons of equipment were removed. Concrete foundations were broken up by means of dynamite, and through the precautions taken, there was no damage done to the power house or to the high-tension bus galleries situated about fourteen feet above.

The erection of the first turbine began on March 1, 1924, the condenser already having been started. On March 25 the turbine was pretty well set up and condenser tubes were being installed. The circulating pump was put in service April 18, being given a fourteen-hour test. Three days later the hotwell pump and air pumps were tried out, and the regular adjustments afterward completed. The generator was tested between April 23 and 26, being phased in on the line the last day after applying the high potential test. Since then it has been in regular operation.

Arc Welding

By Albert Smith

The electric arc welding process has been slow in growth despite a very simple theory. This has been due to scarcity of skilled labor capable of manually controlling the arc as well as to absence of reliable apparatus suitable for performing the actual operation of controlling the heat at the weld, so relieving the operator of holding a fixed arc length.

In the past cast iron has been a stumbling stone for welding engineers. That cast iron can be welded has been demonstrated on a large scale by the successful repairs of the large cast-iron cylinders and machine parts on ships of the German merchant fleet taken over by the government during the war. Such a weld, to be safe, must be free internally from slag and oxide inclusions.

The best results are obtained by the use of a constant-potential non-automatic control system. Research and experiments have demonstrated that the best generator voltage is about 35, which limits the length of arc and insures accurate work. The deposition of clean sound metal in a weld is more or less dependent upon the operator's skill to maintain a short and even arc. With a low-voltage system it is impossible to draw out a long arc between electrode and work. Any good welding system for heavy work should deliver and maintain a critical degree of heat at the weld to insure proper fusion. In the modern welding machine this has been accomplished by automatic current control; that is, the current can be adjusted to suit the fusing point of the particular metals to be welded and the current is automatically maintained at that value.

To insure a tensile strength as great as that of the parent metal, it is necessary to have welding materials of a composition to retain the chemical properties of the parent metal after the welding metal has passed through the intense heat of the arc. Experiments show that during the welding period part of the manganese and some of the carbon and practically all of the copper are burned away in the arc. To weld metal containing 18 points of carbon and, say, 45 points of manganese, it will be necessary to use a welding rod with 24 points of carbon and 75 points of manganese and a small amount of copper. The metal deposited will contain about 19 points of carbon and 50 points of manganese and no copper. This shows how important it is for the plant engineer to select a competent welder when the emergency arises. A fixed voltage, an automatically regulated current of practically any desired value, closely regulated, insures proper and thorough fusion of original and added metal—in other words, a sound and permanent weld.

An increase in efficiency of a 25-ft. head, 15-ft. suction, 60,000 gal. per min. pump of about 10 per cent was obtained by changing the impeller inlet angle from 13 to 10 deg., and by a change of the exit angle of the impeller from 18 to 19 deg.

Sometimes, owing to haste or other causes, a trap has the inlet and outlet connections reversed. Sometimes a low-pressure trap is thoughtlessly placed on a high-pressure job. Sometimes traps are overhauled and not reassembled properly. All these things give trouble.

Operation of Electric Elevator Machines—Drum-Type Equipment

By F. A. ANNETT*

A BRIEF description of the different classes of elevator machines in use is given and then the operation of the drum-type machine is described in detail both for overhead and basement installations.

ELECTRIC elevators have been developed in a great many different forms, but in general they can be grouped in two classes, drum type and traction type. On the drum type one end of the hoisting cable is attached to the car and the other end to the winding drum on which the cables are wound to hoist the car. On the traction type the ends of the cables connect to the car and pass over a traction sheave to the counterweights where the other ends are attached. This traction sheave is either mounted directly on the motor shaft or is driven through a worm and gear, and the friction between the cables and sheaves is depended upon to transmit the driving force from the motor to the car and counterweights.

These two groups can be subdivided according to their types of control into a number of classes. One is semi-magnetic control, in which the machine is controlled from some mechanical device in the car such as a hand rope, wheel or lever. Another very large class is the full-magnetic control, in which the machine is controlled from a switch in the car. Another class that is coming into quite extensive use is the full-automatic controlled or push-button type, in which no operator is employed. In the highest development of this machine, to call the elevator to the floor the passenger pushes the landing button as for the operator-controlled type. However, instead of giving a signal to the operator in the car, when the landing button is pushed, the elevator automatically comes to the floor and stops. After it stops the car gate and landing door open automatically and remain open a definite time to allow the passenger to get on the car, when they again close automatically. The passenger pushes a button in the car of the same number as the floor to which it is desired to go. This puts the car in motion, and it goes to this floor and stops, after which the car gate and landing door open automatically, remaining open a definite time to allow the passenger to get off the car. After the passenger has had time to get off the car, the door and gate close automatically and the car is again available for use by someone else. On the earlier types of this machine the landing doors and car gate were opened and closed by the passenger.

Where Dual Control Is Used

In another class, a combination of hand and full-automatic control is used, and this is known as dual control. During that part of the day when the traffic is heaviest, an operator is on the car and controls it from a car switch. When the traffic is light, the control is thrown over onto the full automatic, in which case the passenger controls the operation much the same as for the full-automatic machine.

One of the latest developments in elevators is that known as "signal-control." In this type the machine is full-automatic controlled in every sense of the word, although it has an operator in the car. In distributing the passengers to the different floors the operator simply pushes buttons in the car corresponding to the floors that the passengers call. After the buttons are pushed the car goes to these floors and stops automatically. When a passenger on a landing pushes a button to signal the operator the first car coming in the direction signaled will stop at this floor.

Micro-drive machines are another development that is coming into quite extensive use. In this type the main machine brings the car within a short distance of the floor at which it is desired to stop. When the operator brings the car switch to the off position, the main machine is switched out of service and a small slow-speed, or what is known as a leveling machine, switches into action automatically and brings the car level with the floor. This machine will also maintain the car level with the floor during loading and unloading and compensate for the stretch in the cables.

Classification of Control Equipment

For machines operated on direct current, the control may be divided into rheostatic constant voltage, where a resistance is used to give reduced voltage at starting; multi-voltage, where means are provided to apply the starting voltage in definite steps such as 25, 50, 75 and 100 per cent as the machine comes up to speed; and adjustable-voltage, where the voltage at the motor terminals is gradually increased and decreased during the starting and stopping period by controlling the voltage of the generator supplying the motor. In alternating current the control can be divided into two general classes—those for single-speed motors and those employed with two-speed motors.

The foregoing in a general way outlines some of the classifications of electric elevators in use, but in this article the drum-type machine will be described in detail. These machines are in general built for two classes of installations—basement and overhead. In Fig. 1 is shown a complete installation of an Otis Elevator Company's basement-type machine for passenger service. This machine is representative of the better classes of drum-type machines in use today with full-magnetic control from an operating switch in the car. Two sets of cables run from the drum *D*—car and counterweight. The car cables run from the back of the drum up the hatchway over a sheave *S* and to the car crosshead *C*. The counterweight cables come from the front of the drum and go under the vibrating sheave *V*, up the hatchway over the overhead sheaves *S'* and down to the drum counterweights *W*. A third set of cables runs from the car to the car counterweights *W'*. The two sets of counterweights are made equal in weight to about 40 per cent of the weight of the car and its rated load. For example, if the car weighed

*Assistant editor of *Power*.

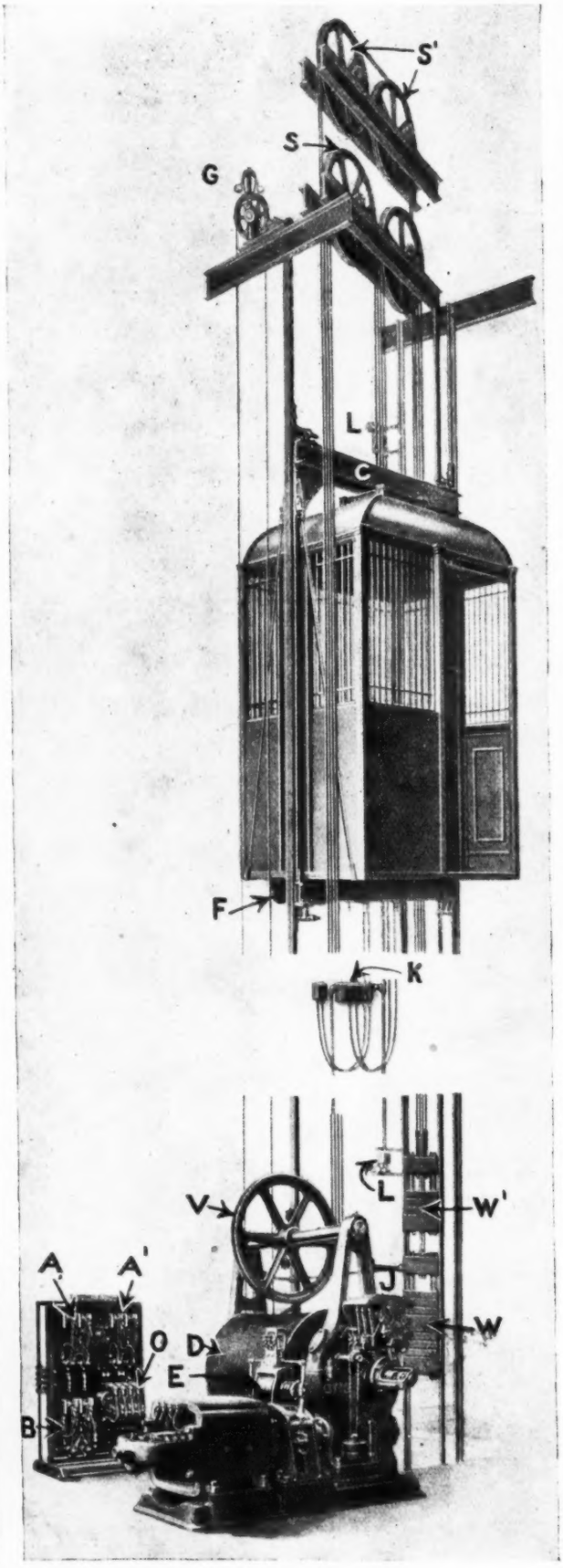


Fig. 1—Typical basement installation of drum-type elevator machine

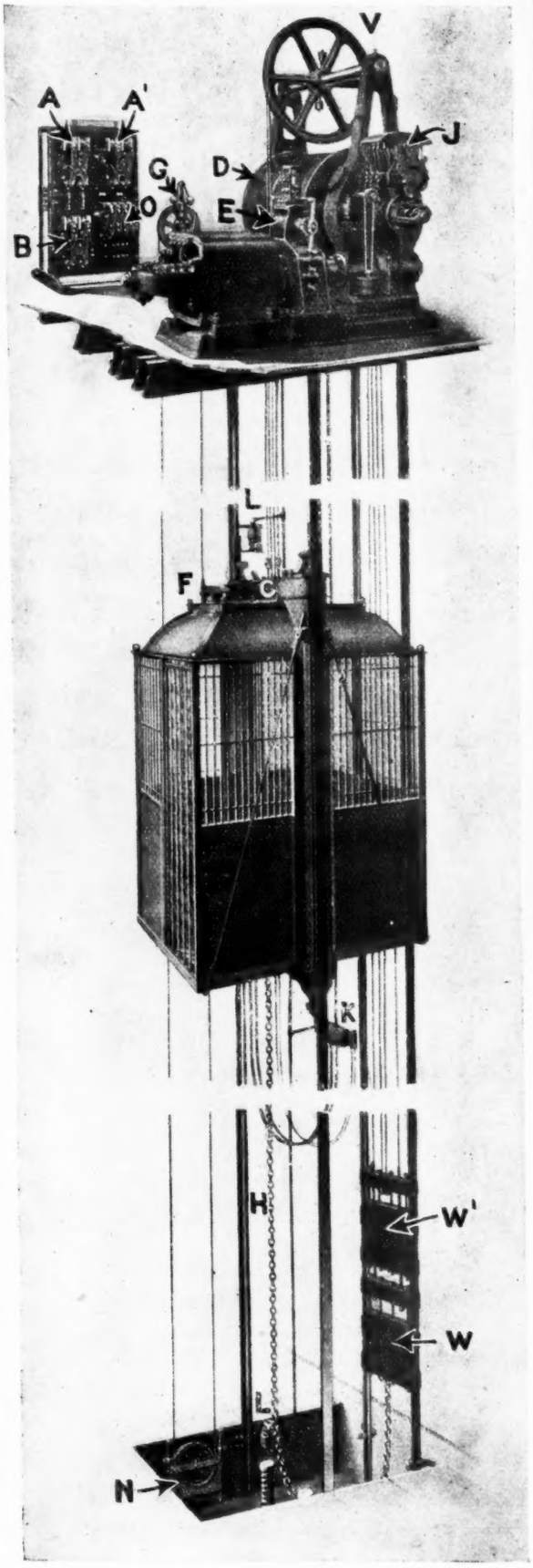


Fig. 2—Typical overhead installation of drum-type elevator machine

1,000 lb. and its rated load was 2,000 lb., the counterweights would weigh 40 per cent of 3,000, or 1,200 lb. This weight of counterweight has been found most efficient for general installations and gives the minimum loading on the machine for average conditions.

With the counterweight equal to 40 per cent of the weight of the car and its load, the motor for driving the machine need be only 60 per cent of the size it would have to be if no counterweights were used, besides making it possible to stop the car and its load with a much smaller brake and also reducing the strain on the elevator equipment in general.

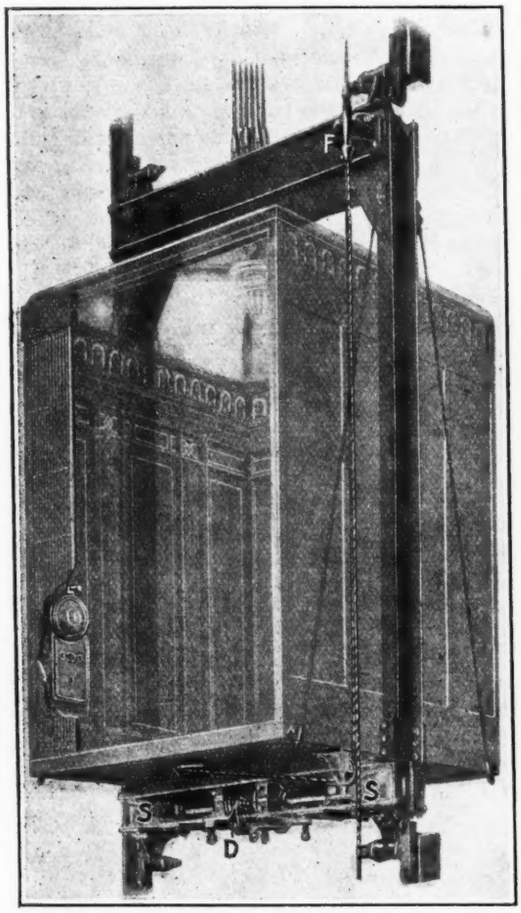


Fig. 3—Elevator car showing location of safeties at S

The cables are arranged on the drum so that as one set winds on the other set unwinds; this allows both sets to make use of the same grooves. To allow the cables to pass to the drum counterweights, the car counterweights are slotted in the back and the cables are covered with steel tubes to prevent abrasion. In all cases the car counterweight cables are placed above the drum counterweights. This is done so that in case the drum counterweight cables were to break, these counterweights cannot fall on the car counterweights and overbalance the car. In such a case the counterweights would fall and raise the car and might cause a serious wreck.

In Fig. 2 a chain *H* can be seen running from the bottom of the car to the bottom of the counterweights. This chain is used to compensate for the weight of the cables being shifted to the counterweights when the car is at the top landing and shifted to the car when at the bottom landing. In the figure the car is shown near the top landing and the counterweights are at the bottom. In this case the weight of four cables for the full length of the hatchway has been shifted to the counterweights and taken off the weight of the car. If the cables weigh 400 lb., then 400 lb. has been taken off the car and put on the counterweights, or there has been a change in weight of 800 lb. between the car and the counterweight in traveling from the bottom to the top landing. In going from the bottom to the top landing, the weight of the compensating chain has been transferred from the counterweights to the car. Therefore, if the chain weighs the same as the cables, as much weight has been added to the car as was removed and the counterweighting remains the same for any position of the car. This compensating chain, or cable as sometimes used, is not necessary except on medium- and high-lift machines.

On the overhead machine, Fig. 2, the arrangement of the cables is similar to that for the drum machine, the chief difference being that the overhead-sheave construction has been eliminated. In the overhead machine the drum counterweight cables come up the front of drum *D* and go down the back to the counterweights, where the car cables come up the back of the drum and down the front to the car. The car-counterweight cables come from the car up over vibrating sheave *V* and down to the counterweights. This is the arrangement where the diameter of the drum equals one-half the width of the hoistway. Where the hoistway is wider than two times the diameter of the drum, deflecting sheaves are used for the counterweight cables to divert them down the hoistway.

The arrangement of the governor *G* and cable can be clearly seen in the two figures. This cable runs over a sheave on the governor and around a weighted sheave *N*, in the hoisting pit, Fig. 2. In this particular installation the two ends of the cable are attached to a fitting *F* at the bottom of the car, Fig. 1, and at the top, Fig. 2. This fitting is held in a clip so that the governor cable moves with the car. The governor is equipped with flyballs similar to a steam-engine governor, which, when the car runs above a predetermined speed, are thrown out and operate a dog that grips the

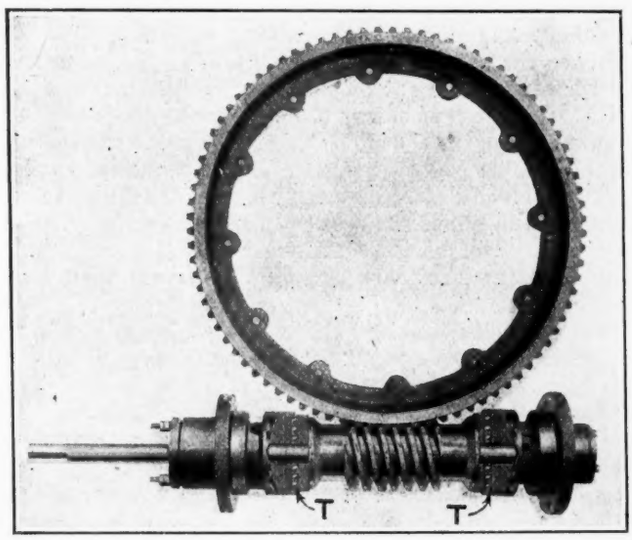


Fig. 4—Worm and gear with ball thrust bearings at T

cable and pulls it out of the clip at *F* on the car. Pulling the governor cable free from the car will set the safeties under the car to prevent it from falling in case it gets out of control or the cables break.

One arrangement for setting the safeties is shown in Fig. 3. One end of a second rope is attached to a drum *D* located in the safety plank under the car. This rope is wound up on the drum, and the other end is attached to the governor cable at *F*. When the governor cable is pulled free from the car, the cable on the drum is pulled out and causes the drum to turn. The revolving of this drum operates right- and left-hand screws which

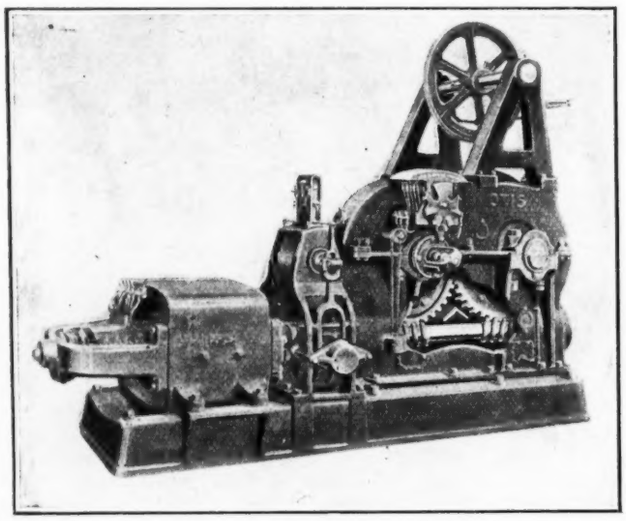


Fig. 5—Tandem-geared elevator machine requires no thrust bearings on wormshaft

force wedges between the ends of the safeties *S* in such a way as to cause them to grip the guide rails gradually and stop the car.

When the safeties are set by action of the governor, the power may be cut off from the motor in two ways on a drum-type machine. In one, when the governor operates, it opens a switch which interrupts the circuit to the holding coil on the main-line or potential switch on the controller, which causes this switch to open and stops the machine. The other method is to allow the car cables to become slack after the safeties set, which will cause the slack-cable switch to open the main-line switch.

The controller used on the machines, Figs. 1 and 2, is representative of those used on medium-speed drum-type machines, in that it has a main-line or potential switch *B*; two direction switches *A* and *A'*, one which closes for up motion of the car and the other for down motion, and an accelerating magnet switch *O* for cutting out the starting resistance. When the operating switch in the car is thrown to the up position, one of the direction switches closes and completes the circuit through the motor's armature in one direction, and when the operating switch is thrown to the opposite position, the other direction switch closes and completes an opposite circuit through the motor's armature, thus reversing its direction and that of the car. These direction switches are so interlocked that one must be open when the other is closed. When the direction switches close, they also close the circuit to the brake magnet coil *E*, which releases the brake and leaves the elevator machine free to be operated by the motor.

To connect the operating switch in the car to the controller, a flexible cable runs from the car to a junction box *K* halfway up the hoistway. This gives a flexible connection that allows the car to travel the full length of the hoistway. From this junction box the wires generally lead to the controller in metal conduit.

On the machines shown in the figures, there are two sets of limits. One of these is at *J* and consists of a number of contactors opened and closed by cams operated from a traveling nut on the end of the drum shaft. The second set is the hatchway limit switches located at *L* near the top and bottom landings. One set of contactors located at *J* are the first to open, as the car approaches the terminal landings, and interrupt the circuit to the direction switch, which should cause this switch to be opened and the car brought to rest. If for any reason the direction switch did not open and the car continued in motion, a second set of contacts would open shortly after the first and open the coil circuit to the potential switch *B* and cause it to open. This would cut the power out of the motor and apply the brake. Should the drum-shaft limits be out of adjustment and allow the car to go by the terminal landing, then a cam on the car would strike one of the hatchway-limit switches *L* and open it. Opening the hatchway-limit opens the circuit to the coil of the potential switch with the same effect as if it were opened from the drum-shaft limits.

Slack-cable and Governor Switches

In addition to the limit switches mentioned in the foregoing, there is the slack-cable switch and in some cases a switch on the governor as previously stated. The slack-cable switch is under the drum and is in series with the holding coil on the potential switch. When the cables become slack on the drum, owing to the safeties setting on the car or other causes, the slack-cable switch is opened, which in turn opens the potential switch and stops the motor. Where a governor switch is used, in case of overspeed that causes the governor to operate and set the safeties, the governor switch is opened and the motor stopped by the opening of the potential switch.

Other important parts of an elevator are the thrust bearings. Owing to the unbalanced weight of the car or counterweights the worm gear exerts a thrust on the worm that must be taken care of by thrust bearings. One common arrangement is shown in Fig. 4, where ball-type thrust bearings are shown at *T*. In other cases roller thrust bearings are used, and again in others, bronze and steel disks are employed. On some types of elevators both thrust bearings are included in the rear wormshaft bearing. This latter arrangeemnt places both thrust bearings where they can be inspected and adjusted without taking out the wormshaft as has to be done on many types of machine in use.

Instead of using a single worm-gear drive, as in Figs. 1 and 2, a tandem worm and gear is employed, as in Fig. 5. The rear gear is mounted on the drum shaft and meshes with the front wheel, the wormwheels being driven by tandem worms. This gearing automatically absorbs the thrust, and no thrust bearings are required.

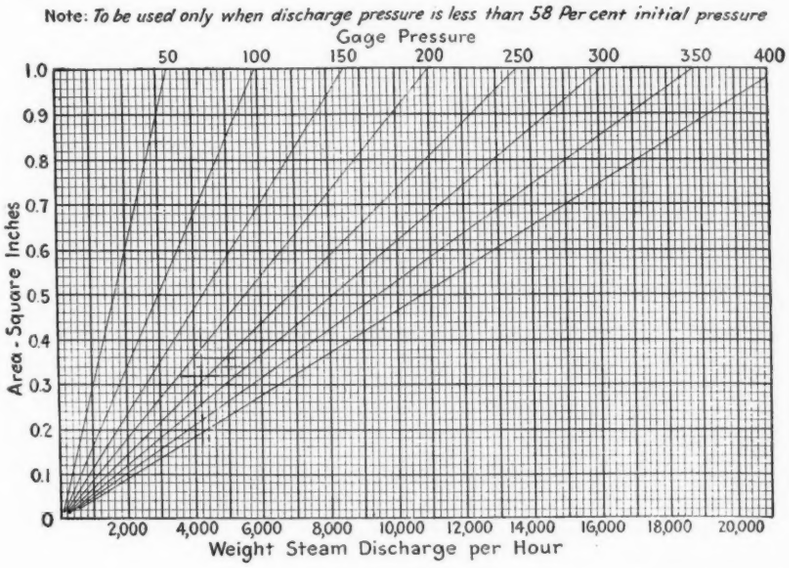
Different makes of elevator machines will have different arrangement and construction of mechanical details, but all drum-type machines are essentially the same as those described in the foregoing.

Simplifying Steam-Discharge Computations

By S. D. BARCLAY
Instructor in Mechanical Engineering, Rensselaer Polytechnic Institute

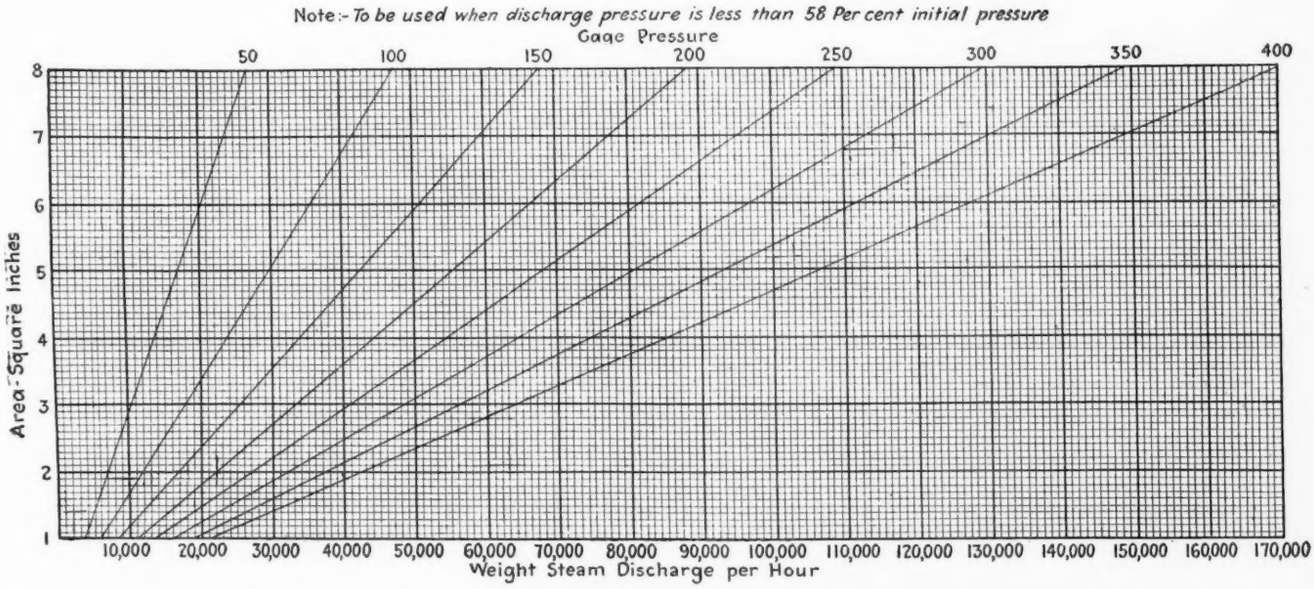
IT IS often desirable to know the weight of steam discharged through a given area, either when the steam has a high degree of superheat or when it is wet, for different conditions of initial and final pressures. There are several long and complex formulas that can be used to solve the problem. Napier's equation or modifications of it form the basis of most of the formulas now used. But Napier's equation, as it stands alone, gives the weight of dry saturated steam discharged when the final pressure is less than 58 per cent of the initial pressure. For any other condition it is not directly applicable, and the long formula must be resorted to.

Since superheated steam occupies a larger volume per unit weight than does saturated steam, it is obvious that the weight of superheated steam discharged per unit time should be less. Likewise, when wet steam is being discharged (it having a smaller volume per unit weight than dry saturated steam), the weight discharged per unit time is greater than that given by the formula. Also, if the discharge pressure is more than 58 per cent of the initial pressure, the weight discharged in either case will be less than that discharged when the final pressure is less than 58 per cent of the initial pressure. Therefore, certain coefficients must be used to give correct values when the conditions are different from those for which Napier's formula is intended.



Figs. 1 (left) and 2 (below)—Diagrams for dry saturated steam where discharge pressure is less than 58 per cent of initial pressure.

It will be seen that Fig. 2 is merely an extension of Fig. 1 up to a discharge area of 8 sq.in. If the area is given, the normal flow may be read directly from these charts. Where the steam is wet or superheated or the final pressure greater than 58 per cent of the initial, the results obtained from Figs. 1 and 2 must be corrected by multiplying by coefficients or factors obtained from Figs. 3, 4 and 5.



The data for the accompanying curves are all based on actual tests and are taken from Marks' "Mechanical Engineers' Handbook," Kent's "Mechanical Engineers' Handbook" and Prof. J. A. Moyer's "Steam Turbines." These curves have proved to be a quick and convenient method for finding areas for given discharges or the amount of steam discharged for given conditions when

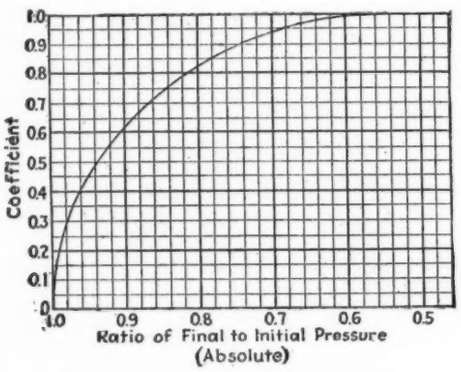


Fig. 3—Correction coefficient for back pressures greater than 58 per cent of initial

the area is known. The curves may be relied upon to give results within two per cent.

The problems met may be divided into two general types—those where the weight of steam discharge is wanted, and those that require the discharge area.

Where the area is given, the first step is to read from Fig. 1 or Fig. 2 the weight of dry saturated steam delivered per hour when the back pressure is less than 58 per cent of the initial. If the actual steam is wet or superheated or if the back pressure (absolute) is more than 58 per cent of the initial, the necessary corrections are read directly from Figs. 3, 4 and 5. The corrected discharge is then the product of that read from Fig. 1 or 2 by the various coefficients.

As an example assume that it is required to find the weight of 90 per cent dry steam that will be discharged

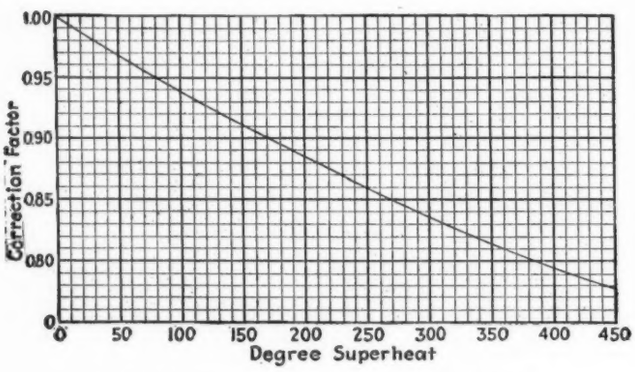


Fig. 4—Correction factor for superheat

through a 0.5-sq.in. orifice if the initial pressure is 200 lb. gage and the back pressure is 2 lb. gage. The uncorrected discharge, from Fig. 1, is 5,550 lb. per hour. Fig. 5 gives 1.05 as the correction factor for steam quality. There is no correction for back pressure since the absolute back pressure is obviously less than 58 per cent of the initial. Then the actual discharge will be $5,550 \times 1.05 = 5,827$ lb. per hour.

A similar problem involving correction for superheat and back pressure is as follows:

Initial pressure..... 200 lb. gage.
Discharge pressure..... 150 lb. gage.
Superheat pressure..... 300 deg. F.
Area..... 0.75 sq.in.
Find weight discharged per hour.

Fig. 1 gives a normal discharge of 8,300 lb. per hour. The ratio of absolute back pressure to absolute initial is $165 \div 215 = 0.767$, so (from Fig. 3) the back-pressure coefficient is 0.87. The coefficient corresponding to 300 deg. superheat is (from Fig. 4) 0.837 F. Therefore the corrected discharge is $8,300 \times 0.87 \times 0.837 = 6,044$ lb. per hour.

Perhaps a more common type of problem is that in which it is desired to find what area is required for a given flow. In problems of this sort the coefficients are looked up first. The desired flow is then divided by all the coefficients to get the equivalent discharge under standard conditions. Fig. 1 or Fig. 2 is entered with this equivalent discharge to get the required area in

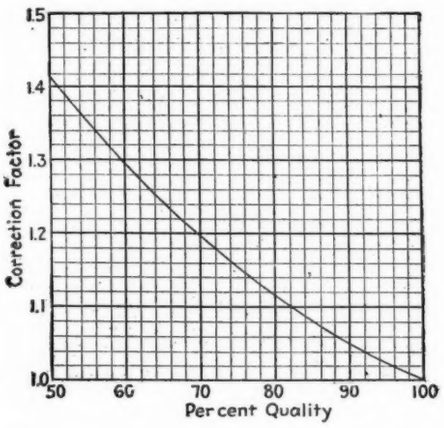


Fig. 5—Correction factor for wet steam

square inches. As an example consider the following problem:

Initial pressure..... 250 lb. gage.
Discharge pressure..... 175 lb. gage.
Quality..... 85 per cent.
Weight discharged steam.. 20,000 lb. per hour.
Find area.

The ratio of absolute pressures is $190 \div 265 = 0.717$, for which Fig. 3 gives a correction factor of 0.925. The quality factor, from Fig. 5, is 1.08. Therefore the equivalent discharge is

$$\frac{20,000}{0.925 \times 1.08} = 20,020 \text{ lb.}$$

From Fig. 2 the proper area is 1.50 sq.in.

A similar problem with superheated steam follows:

Initial pressure..... 300 lb. gage.
Discharge pressure..... 25 lb.gage.
Superheat..... 200 deg.
Weight discharge..... 15,000 lb. per hour.
Find area.

No back pressure correction is necessary. The superheat correction factor is 0.884. Then the equivalent weight is $15,000 \div 0.884 = 16,970$ lb. per hour. Fig. 2 shows that a 1.08-sq.in. orifice will discharge 15,000 lb. per hour under the given conditions.

Saginaw River Steam Plant Costs Explained

By H. F. EDDY

THE design of the Saginaw River Steam plant is of particular interest because of its low cost—$71 per kilowatt of rated capacity—and because it has been calculated from apparatus manufacturers' guarantees that the coal consumption can be held down to one pound of good West Virginia coal per kilowatt-hour of net output when the units are operated at their most economical loads, about 16,000 kilowatt each. When maximum steam and vacuum conditions are maintained, the figures show that 13,000 B.t.u. should produce a kilowatt-hour for delivery to the transformers.

Some unusual or unique features of the design are the use of very small condensers, heavy extraction of steam from three stages of the turbines for preheating both feed water and forced-draft air, underfeed stokers driven by hydraulic oil pressure developed by rotary displacement pumps, water and steam-cooled furnace walls, all piping under comparatively low pressures except steam mains between boilers and turbines and the boiler feed lines, and coal and ash handling apparatus designed for exceptional labor saving.

The description of the new Saginaw River steam plant of the Consumers Power Co. in the July 22 issue created considerable interest not only because of the innovations in design but also because of the exceptionally low cost—$71 per kilowatt of rated capacity. In explanation of this low cost and of the anticipated economies, H. F. Eddy, mechanical engineer of the company, presented a paper before the Great Lakes Division of the N. E. L. A. at French Lick, Ind., on Sept. 27. Excerpts from the paper follow.—Editor.

The principal conditions governing the design were as follows:

The plant must take care of base load as well as back-up water power. A 50 per cent annual load factor is anticipated. As the load and the steam plant grow, it will be possible to keep each unit running at its economical rating or shut it down altogether. This is because the storage ponds of the hydro-electric plants can be varied a few inches and made to store or yield a quantity of power that would be equivalent to the operation of a 20,000-kw. turbine for many hours.

Dependability is a requisite, but not to the extent that it would be if it were not for the inter-connection through large capacity and very reliable transmission lines with many other steam and water plants of the Consumers Power Company's system. In other words, spare or duplicate apparatus and facilities for attempting absolutely continuous operation at any required capacity is not demanded, as it might be in a central station steam plant not interconnected with other power sources, and this plant can in effect store power as pent-up water behind the dam. Opportunity for extensive overhauling of apparatus can always be found for two or three months during the spring flood period of the Michigan rivers. However, not for any such reasons should one avoid the duplication of boiler-feed lines, pumps, coal-handling motors and other equipment, the failure of which could prevent the use of the larger units of apparatus, or make the plant unsafe.

Herewith is a tabular statement of the capital costs to date of the plant.

The accomplished low capital cost of the plant and the promised low operating cost will now be explained. To keep down the building costs, a very high steaming capacity had to be obtained so that a comparatively small boiler heating surface installation could be set in a single row of units parallel to the shafts of the turbines, which are set end to end with spaces between generators ample for completely pulling out the field rotors. A study showed that the plant should be built upward rather than spread outward. Consequently, the economizers, induced-draft apparatus, coal bunkers and a large part of the coal handling apparatus are set above the boilers. All high-tension electrical apparatus and the auto transformers are in the outdoor substation.

Sound clay foundation determined the elevation of the building base mat at a point just below the frost line. Anticipated flood elevation settled the top of the concrete building foundation walls at 23.5 feet higher. The turbine and boiler floor were constructed at this flood limit. The small surface condensers and ash sluicing device permitted a shallow basement. A crane high enough and of sufficient capacity to handle a 35,000-kw. turbo-generator determined the elevation of the turbine-room concrete roof, which is considerably below that of the boiler-room roof where the economizers limit

COST OF THE SAGINAW RIVER STEAM GENERATING PLANT AT ZILWAUKEE, MICHIGAN

	Complete Cost	Per Cent
Building and all foundations, including excavation, coal hoppers, side tracks, coal bunkers, stacks, etc.	$380,727.52	13.40
Crane	13,638.00	0.49
Boilers and settings	286,398.18	10.10
Stokers and forced-draft fans	118,196.87	4.16
Economizers, induced-draft fans and breechings	90,351.75	3.18
Superheaters	73,872.34	2.60
Water-cooled furnace walls	90,920.00	3.20
Coal-handling equipment	63,302.75	2.24
Ash-disposal equipment	9,092.18	0.32
Boiler-feed pumps	14,092.60	0.49
Air preheaters	39,777.41	1.40
Turbo-generators and auto-transformers	800,664.87	28.20
Condensers	92,056.00	3.25
Feed-water heaters	22,730.67	0.80
Cold water and condensate pumps	7,490.90	0.26
Air and oil coolers	22,730.89	0.80
Oil filters and tanks	7,955.49	0.29
Station piping	125,015.23	4.40
Electrical equipment:		
Switchboard	45,460.71	1.60
Station wiring	79,555.16	2.80
Conductors and supports	91,102.19	3.2
Cooling Water Intake and Conduits:		
Intake and water conduits	45,523.13	1.6
Circulating pumps and other equipment	14,774.53	0.52
Piping	2,841.25	0.10
Wiring	11,365.37	0.40
	$2,549,635.99	
Overhead:— Engineering, Office Management, and Interest	290,364.01	10.2
Total cost	$2,840,000.00	100.00

the height. Sufficient width was allowed in the turbine room to allow a temporary standard railroad track to extend into the building where the turbine floor has been omitted to give light and crane access to the basement on the east side. Close outside the west wall of the boiler house and running parallel at the flood elevation is the permanent coal siding through which coal dumps into the hopper and automatic skip loader. These two tracks were put in place as early as possible and proved of great advantage in construction work. By placing the circulating pumps at the river, much excavation was saved in that the concrete intake ducts only had to be placed below frost danger.

Boiler Plant Cost Factors

To keep down the boiler heating surface to the amount that could be installed in a building as described above, a plant of economical steam consumption in which its boilers could be operated at very high ratings was required. Investigations made in 1922 showed that, for steam pressures a little under 400 lb. and for steam temperatures not over 700 deg. F., reliable guarantees on boilers, turbines and auxiliary apparatus could be had, and the costs would be only a little higher than what the recently standard 250 lb., 600 deg. F. equipment would cost. But if one tried to exceed those steam conditions, costs jumped at once into figures that would stagger any reasonably conservative property owner. This is especially true of the boilers. Thus we were limited and in order to keep down the cost and size of the station, we had to look for steam and heat consumption economies in other directions, which were, of course, easy to find.

With preheated air and stokers capable of burning a ton of coal per retort per hour, it was thought necessary to prevent excessive furnace temperatures or at least provide furnace construction sufficiently good to withstand them. This led to the use of the radiant-heat superheaters and water-cooled furnace walls. Only small sections of firebrick are exposed to the furnace heat, and these are partly air-cooled and are all supported by plenty of air-cooled structural steel rigidly supported. Steel jacket plates cover the steam and water-cooled surfaces on the side away from the fire, but the rest of the settings are faced outside with a dense salt-glazed firebrick set in mortar. This furnace design provides for operation up to 165,000 lb. of steam per hour per boiler.

The decision to use underfeed stokers had a very important bearing on the design, the space required and the cost. No such steaming rates per cubic foot of building space have been attempted with other kinds of stokers nor with powdered coal. Nothing was found to show that the latest types of underfeed stokers with clinker grinders have not at least equaled in efficiency anything that has ever been reported by the users of other devices for firing good or bad coals under steam boilers. Comparisons with plants using chain-grate stokers or pulverized-coal apparatus show at first glance that the Saginaw River boiler units occupy far less space and that the expense of installation complete with building, piping, coal-conveying apparatus and many other things must have been greatly reduced because of that space saving.

The Saginaw River water is so badly contaminated with sodium chloride and a great variety of other impurities that evaporators are required. Chemical treatment cannot possibly make it fit for feeding high capacity boilers. The cost of the evaporator equipment was kept very low by using two single-stage low-pressure units, one connected between the eighth and eleventh stage extraction nozzles of each turbine where the temperature range happens to be less than the high limit recommended by the manufacturer.

There was no question as to the advisability of using economizers with the high-priced coal. The uncertainty as to the durability of the steel-tube economizer was not cleared away at the time the design was developed. This led to adopting the standard cast-iron machine and installing it with vertical baffling to increase the gas travel as we had previously done at Battle Creek. However, the boiler pressure was too high for cast-iron tubes, and it was decided to operate the economizers at an intermediate pressure of about 175 lb. This required pumping the water from economizers to boilers. It should be noted that economizer surface was found to the cheaper than steel-tube boiler surface. Therefore, the boiler was cut down and the economizer increased so that 8,500 sq.ft. of economizer surface was installed in connection with each 9,280 sq.ft. of boiler surface. The reduction in pressure on the economizer and its piping resulted in a considerable saving.

Steam preheaters for forced draft air were chosen because their installation permits the neatest and most compact arrangement and since they increase the efficiency of the turbines and relieve the condensers of the work of wasting additional heat to the river.

Overcoming Initial Troubles

No operating data that would not be misleading can be given at this time, as we are just at the present clearing up some difficulties that have prevented normal operation. The principal troubles have been as follows:

Delayed combustion, excessive cinders and smoke: This has already been largely overcome by replacing tuyeres with ones of larger air openings and by changing baffling in the windboxes.

Leaky superheaters: This caused evaporator capacity to be exceeded and the impure Saginaw River water to be admitted to the boilers. The boilers discharged water with impurities through superheaters, piping and turbine. Loss of superheat, scaling and corrosion resulted. Improvements in the welding and supporting of the radiant-heat superheater elements and the installation of steam purifiers in the boiler drums are the measures being taken to assure the correction of these difficulties.

The first turbine was started in March. Trouble was experienced with it after several days of operation. The second turbine was ready for use in August, and No. 1 turbine was then opened. It was found that numerous iron and steel chips had passed into it and caused considerable disfigurement of buckets and nozzles. The first wheel buckets were badly battered down. The result was that the capacity of the turbine had been reduced to 17,000 or 18,000 kw.[1] Salt crystals and corrosion of the steel blading of the last three stages were also found.

Excessive air leakage through boiler settings and around flues, also wrong combustion conditions have caused the overloading of the 150-hp. induced-draft fan motor. This has limited the boiler capacity to about 130,000 lb. per hour per boiler.

[1]The two turbo-generators are each rated at 20,000 kw. and the plant contains four boilers.

A Commendable Precedent

H. F. EDDY'S paper before the N.E.L.A. at French Lick sets an example that might well be emulated by others. Not only does he set forth the reason for selecting certain types of equipment and trace their influence on station cost, which is given in detail, but he also has not hesitated to relate troubles encountered when breaking in the plant. Knocking down the bugaboo of fancied misuse by radicals, he has the temerity to bare to public gaze, *costs* and *troubles*—two things which most executives and engineers have been taught to guard as they would their family secrets.

It is true that total cost figures alone are of little use and likely to be misleading. But when given in detail followed by explanations of local conditions and the engineering reasons involved, they become most useful data of a kind that designing engineers are craving for. Is it too much to expect that some of these gentlemen who have shown such keen anticipation over the Saginaw figures may be prompted to apply the golden rule?

In view of the performance predicted by the designers of this plant, about which there has been some skepticism, the operating results will be awaited with interest. It is assumed that Mr. Eddy, following the precedent with reference to initial costs, will make available to the engineering profession the operating figures when the proper time has arrived.

Wasting at the Spigot

IN PURCHASING prime movers it is a universal practice for the consulting engineer to tabulate the guaranteed efficiencies of the several designs of boilers and stokers. In fact these tabulations are often the determining factors in the purchase. It is of vital importance to generate steam at the lowest possible cost but as Charles P. Putnam states on another page, "Great attention is paid to the economical generation of steam but very little to its use after it leaves the power house." How true this is may be determined by an investigation of any factory where process steam is used. It will be found that in most instances the management places no restrictions on the amount used in the vat, cooking kettle, dry room or other equipment. The workman is permitted to open the control valve to give its maximum discharge and maximum pressure. Save in a few notable exceptions no one has made any extensive tests to discover how little steam can be used without slowing up the process or what steam pressure gives the best results. Workmen are seldom scientists or even engineers and too much should not be expected from them in the way of advocating new methods, but under proper direction a lot can be done to reduce steam consumption, especially where each department is charged with the steam it uses. Occasionally it is found expedient to resort to subterfuge, such as one engineer did when he found that the kitchen force in a hotel insisted that they must have fifty pounds pressure on the steam tables. By resetting the gage needle they still got fifty pounds although the engineer was supplying steam from the engine exhaust at ten pounds.

Future of the Oil Production Business

IN AN address before the Internal Petroleum Congress, George Otis Smith, Director of the U. S. Geological Survey, called attention to the lack of co-operation between oil producers and by inference, suggested that the solution of the economic distress now existing in the oil-producing business was the control of production in accordance with the market demand.

The trouble with the oil business is that those in it expect to get rich too quick. The discovery of a new oil pool occasions a rush of optimists quite like those in the early gold-mining days. The result is that instead of one or even a dozen operators controlling production in any given pool there are thousands of drillers punching holes in leaseholds of town lot size. The holder of each lease must, to protect his own interest, put down as many wells as he can.

If it were possbile for producers to pool their holdings the number of wells, each of which costs now from thirty to a hundred thousand dollars, could be largely reduced at a huge saving. The output could be regulated to meet market conditions. Such a plan could result in the oil-producing business developing into an industry of stability and profit. Of course it may well be argued that business ethics have not improved to a point where we should be willing to allow a combination to control production of any commodity. The alternative is some form of government control, and if this be through an intelligent and honest agency much good and little harm would result from the elimination of the present unbusiness-like conduct of a most important industry.

Wet Steam Still Objectionable

SINCE the steam turbine has come into such wide use, less is heard about the dangers and drawbacks of wet steam. It is true, slugs of water do not constitute so great a potential danger for the steam turbine as with reciprocating engines. There are no cylinder heads to blow off or connecting rods to buckle, though of course a slug of water may still rupture a steam pipe. But wet steam, though less spectacular, may have far-reaching consequences with the steam turbine. It causes attrition and erosion of the blades and buckets, produces corrosion and often creates a deposit which may not only be corrosive, but, which, through accumulation, may be the initial cause of unbalancing. It interferes with the thermodynamic efficiency, of course.

The use of superheated steam has done much to lessen the entrained moisture. In many plants moisture is ignored altogether, the impression being that the installation of the superheater settles the problem and eliminates the condition once and for all. Unfortunately, numerous instances show that wet steam still persists or exists occasionally and, because unsuspected, creates troublesome and often costly conditions. However, these conditions are not quite so widespread as before the superheater was installed.

Where priming or foaming occurs, moisture and foreign matter frequently are carried over into the superheater, where they collect, to be acted upon later by the moisture in the steam and the heat. Hydrochloric and other acids may form and cause rapid corrosion, or the foreign matter ultimately may clog the superheater.

With the rapid growth of the steam turbine and the wider usage of superheated steam there has developed a tendency to do away with the steam separator. In certain cases this may be sound practice, but the fact should not be overlooked that the steam separator is the last-line trench between the boilers and the prime movers. It collects most of the entrained moisture in the steam and serves the further purpose of holding back foreign matter that may be brought over with the condensate.

Steam Temperature Progress Important

EIGHT years ago, a power plant with a rated steam temperature of approximately seven-hundred degrees began operation, but not until the past year or two has such a temperature been widely adopted. Only recently have standards been approved for pipe flanges and fittings at seven-hundred and fifty degrees.

Maximum steam pressures are being practically doubled as represented by the Philo station at six hundred pounds and will be again doubled at Weymouth with one thousand two hundred pounds; temperatures however seem to have reached a saturation point. Recent investigations show that even present testing methods are unsuited to materials at higher temperature ranges. An immense amount of research work remains to be done in order to develop such materials and check their behavior. One thousand degrees Fahrenheit appear as a limit for some time to come.

There can be no doubt of the interest displayed in power plant progress by the manufacturers and operators, judging by recent developments. Nevertheless, it has in a few instances been true that equipment suitable for advanced steam conditions could not readily be procured. An ever-present problem is to determine how far ahead research and development should be carried.

Prestige resulting from a forward step has in many cases been a substantial stepping stone to financial returns, but efforts unsuccessfully applied are undesirable to an equal or greater extent. Progress must be watched and weighed, so that the trend and probable extent thereof can be gaged to best advantage.

In spite of the apparent temperature limit in view and the many problems remaining to be solved by commercial operation, it must be remembered that the limit of an energy cycle efficiency depends more vitally on temperature than pressure. While Carnot efficiency may be closely approached by sufficiently elaborate equipment, it cannot in any case be exceeded. The improvement that is still possible at present maximum steam temperature is thus rigidly limited.

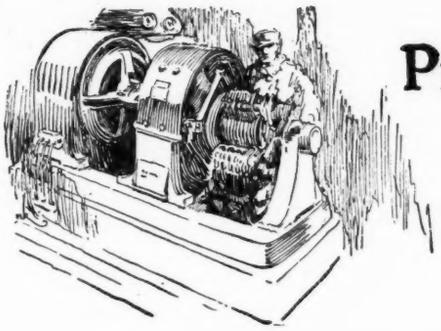
Since increased temperature raises this efficiency limit, a less elaborate and more wasteful cycle which utilizes a large temperature range, may thus be enabled to produce greater net returns for fuel consumed, than a perfect power plant at a lower temperature range. Notwithstanding the apparent temperature limit for steam cycles which has been long in view, there will nevertheless in all probability be strong incentives to utilize temperatures higher than now generally contemplated. The possibilities of steam are by no means exhausted and further advances are likely to increase facilities for energy storage and distribution, besides tending to pave the way for other working fluids also deserving of consideration.

What is the Combustible Loss?

THE fraction of the total weight of coal fired, appearing as refuse in the ashpit is figured by dividing the fraction of ash in the coal by the fraction of ash in the refuse. The same result (at least theoretically) may be obtained by dividing the total weight of refuse by the total weight of coal fired. The ratio of refuse to coal having been obtained in either of these two ways, the weight of combustible lost is obtained by subtracting the true ash from the refuse. These computations are correct on the assumption that none of the ash goes up the stack. While this assumption is substantially correct in cases where the draft is not high enough to carry appreciable quantities of fine coal and ash up the stack, considerable error is involved if it is applied without correction to furnaces burning pulverized coal, or to stoker-fired furnaces operating at high rates of combustion.

Even where correction is made for solid material carried up the stack, another error of appreciable size is frequently made in figuring the heat value of the combustible. This occurs in the common assumption that the combustible matter in the refuse has the same composition as that in the coal. It is obvious that the heat value of the refuse combustible is higher than that of the coal as fired. The assumption just mentioned takes account of this fact. On further consideration, however, it appears that the combustible in the refuse is like that in the coal in one respect only, namely, that it is free from ash and moisture. It differs markedly in the ratio of volatile matter to fixed carbon. If the coal as fired contains fifty per cent of fixed carbon, and thirty per cent of volatile matter, the combustible in the coal is three-eighths volatile and five-eighths fixed carbon. It is hardly conceivable that the coal which reaches the dump plates of either underfeed or chain-grate stokers contains any appreciable amount of volatile matter. Some volatile matter might be carried by coal sifting through the grate before it had been exposed to furnace temperatures, but in any case, for the coal analysis given, the combustible in the refuse would contain much less than three-eighths volatile matter. In most cases it would be practically pure carbon.

Since this is the case, what justification is there for the extra labor involved in figuring the heat value of the combustible in the coal, and applying this value to the combustible in the refuse? Why not simply charge off the combustible in the refuse at the rate of 14,600 B.t.u. per pound, the heat value of carbon.

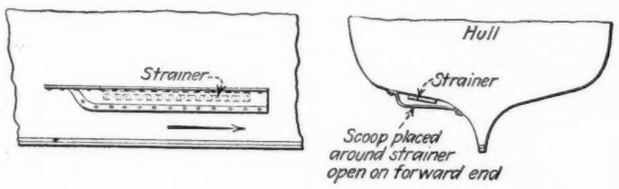


Practical Ideas *from* Practical Men

How the Injector Trouble Was Overcome

Realizing that there are many marine engineers reading *Power*, I am submitting a kink that I hope will help them as it has helped me in my boat.

My boiler-feeding equipment consists of a pump and two injectors. The feed water on entering the boiler is passed through a heater in the upper part of the drum. I generally use the injectors for feeding, but



Arrangement of scoop over suction strainer

until the suction was fixed, I had considerable trouble due to their breaking when I was working in the engine room.

Recently, while we were in drydock, we had a scoop placed over the injector-suction strainer facing forward, as shown in the illustration, and this has entirely overcome the trouble. The injectors are of the double-tube type and must be restarted every time they break.

Old Forge, N. Y. R. G. SUMMERS.

Some Causes of Knocking in the Reciprocating Engine

Most engineers know how perplexing a knock or pound in an engine may become and how difficult it frequently is to determine the exact location of the knock. Perhaps the most common cause for knocking is improper alignment, and this can be corrected only by adjusting the working parts to a line. There are other causes; for instance, crosshead pins and crankpins wear unevenly and cannot be properly adjusted. At dead center they may seem all right, but will be quite loose at the quarter points. The only remedy is either to replace the pins or have them trued up in a lathe.

Probably the most difficult knock to locate is that caused by a loose flywheel or belt pulley. Engines with shaft governors having several moving parts are often noisy when these parts become worn. Generally, it is necessary to rebore the bearings and fit new bushings and pins. It is not uncommon to hear pounding from such engines caused by a fluctuating governor. This kind of pounding is usually traceable to one of two causes—either the governor parts themselves are set up too snugly or the packing gland on the valve rod is turned up too tight. Perhaps the most common cause of flywheel failure is some fault in the operating condition of the governor. The operating engineer should therefore give particular attention to the maintenance of all parts of his engine, especially those connected with the governing mechanism.

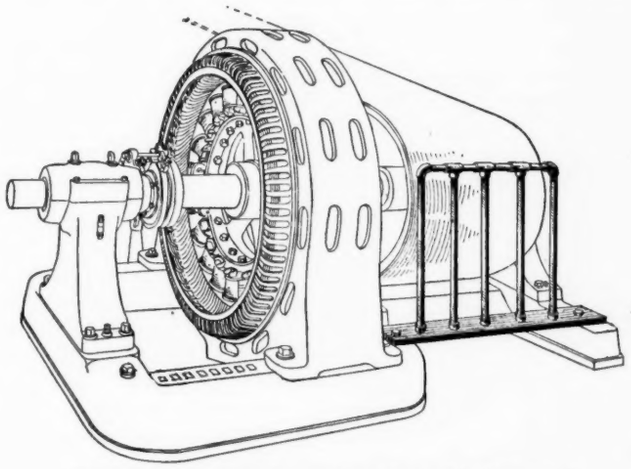
Occasionally, an engine operates with clicking noises emanating from the cylinder and steam chest. These noises may be caused by different things. Often a piston ring overtravels a steam port too great a distance, and the steam pressure compresses the ring until the piston moves back in the cylinder and the ring assumes its normal shape, thus causing what is known as a "spring slap."

Incorrect valve setting is also a cause of clicking noises. If the compression pressure exceeds the initial steam pressure, the valve will be lifted from its seat. An indicator diagram will help in locating and correcting a situation of this kind. Sometimes piston rings become sufficiently worn to cause a rattle or clicking noise. This can be remedied only by fitting new rings.

Albany, N. Y. ALBERT SMITH.

Belt Guard Made from Pipe

Belt guards should be constructed so as not only to prevent attendants and others that may be working around a machine from coming in contact with the belt, but also to prevent the belt hitting anyone should it



Shows location and construction of belt guard

come off the pulley or break. With this object in mind the guard shown in the figure was constructed of one-inch pipe and supported from the motor's base by a ½x3-in. iron plate.

The construction of the guard and how it is mounted on the motor base is indicated in the figure. With the exception of the base the guard is made of pipe and pipe fittings. Connection to the base is made by thread-

ing the ends of pipes long enough to allow a nut on top about ½ in. in length and an ordinary conduit bushing on the bottom. The nuts used on the top of the base are sections cut from the ends of pipe couplings.

W. H. HONSBERGER, Chief Electrician,
Canadian Mead Morrison Co.
Welland. Ont., Canada.

The Art of Manufacturing Power Economically

Choosing the best and highest priced coal for ordinary manufacturing purposes is certainly not sane engineering. Power, being only another product of our factory and coal the biggest item of expense in its manufacture, should be reduced to a common basis for cost. To get to the heart of the matter, the real job is to make steam at the lowest possible cost. This, in turn, reduces to a combination of the cheapest coal that can be burned efficiently and a proper combustion system that will produce liberal returns on the investment.

The art of burning coal efficiently is comparatively simple, depending almost entirely on the furnace construction and combustion equipment. Strict attention must be paid to both these factors in their proper relation to the rating at which the boilers are operated. The most limiting factor, undoubtedly, is the boiler setting. High volatile coals must be burned with a high setting and large combustion chamber to allow proper mixing of the gases and to insure complete combustion. Low settings will result in the gases being cooled before ignition, resulting in smoke and a large combustible gas loss up the stack. With low settings the low-volatile coals only may be burned, although these coals can be efficiently burned with high settings. It is good practice to set the boiler a little higher to allow for any subsequent changes in coals and firing methods. In many plants that I have visited to study the possibilities of changing over to more suitable combustion systems, I have found the limiting factor to be low furnace settings.

More often the factor of poor combustion equipment has to be considered. It is surprising to discover how many plants stick to old methods of firing or persist in burning high-grade fuel simply because the steam is being comfortably supplied. With them the easiest way is still the best way and the coal is purchased without reference to any of its qualities except price per ton. Particularly is this true in plants located in and near the authracite-coal fields.

It is astonishing to see how many plants are still burning soft coal on stationary grates while within easy reach low-grade anthracite that can be burned at a saving of from 20 to 30 per cent in the annual coal bill, goes begging. Equipment to burn this fuel has been found to pay for itself in less than two years and there are some instances, where the equipment has paid for itself several times over in one year.

No less surprising is it to note how many plants are burning No. 1 buckwheat on herringbone grates and natural draft. The surprising thing about these plants is that they are perfectly satisfied with conditions on the grounds that their coal consumption is low.

A member of a noted New York firm of consulting fuel engineers wrote concerning one of his clients, "The old story was found—No. 1 buckwheat being burned on herringbone grates with natural draft and a feeling of profound satisfaction prompted by a small annual coal consumption. After an hour's talk, I succeeded in convincing the manager that he was throwing away about $2,000 a year in his coal bill."

Incidentally, this concern is now in the act of purchasing dumping grates and steam blowers to burn rice coal. The use of steam blowers is here to be recommended. The steam will cause stubborn clinkers to disintegrate and allow the air to filter through the fuel bed. With average care steam blowers should not require more than 3½ per cent of the total steam generated. This is comparable with the steam consumption of engine-driven fans or turbo-blowers.

A mistaken illusion concerning the use of rice, barley or river coal and screenings is that the boilers cannot be forced up to higher ratings at short notice. This in most cases is the result of prejudice against hard coal because of the increased ash. Probably a deep-seated reason is that the majority of engineers have tried to burn hard coal with soft-coal equipment and have made a miserable failure of it.

Great benefit may be derived from the experience of a large Philadelphia textile mill with three 6,000 sq.ft. water-tube boilers. This plant had been running along contentedly burning 150 tons soft coal per week at $6 per net ton delivered. An engineer, whose company manufactured a hopper-feed anthracite stoker, tried to interest the manager in the savings possible with the use of cheaper fuel. The objection of this manager was that he had a heavy dye-house load every morning and was skeptical about the ability of the boilers to meet this demand for steam using anything but soft coal.

No doubt it was a hard fight, but today this plant boasts of three anthracite stokers. Two hundred tons of river coal and screenings are burned per week at $3 dollars per gross ton delivered, effecting an annual saving of about $16,000. With the present equipment and burning river coal the boilers can be forced from 100 to 150 per cent of rating in about six minutes. A certain amount of fine stuff does blow over into the combustion chamber but it never becomes a serious problem. The ash to be handled has increased considerably, but in the face of the large savings obtained, a little extra labor can easily be afforded.

What is true of the plants mentioned in the foregoing can be true in hundreds of isolated power plants where the managers are still satisfied with merely comfortable results, instead of seeking to produce steam on a cost basis. The art of manufacturing power economically is simply the application of common sense fundamentals, both in the choice of a proper combustion system and in its efficient operation.

Philadelphia, Pa. IRVIN R. HOFFMAN.

How to Keep Gate Valves Tight

To keep gate valves tight in service I have found it to be a good plan after the valve has been closed for some time and the pressure reduced from 150 to say 50 lb., to move the wedge or gate back and forth about a ¼ in. This tends to grind up any dirt that may be between the gate and the seat. The valves at the header on my boilers have been in service for twenty years and are still tight. ROBERT A. DAVIDSON.

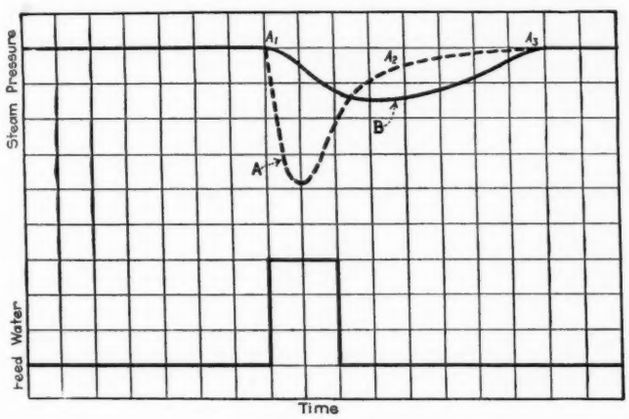
Colton, Calif.

Comments from Readers

Pressure Drops When Feeding Boilers

In reply to the inquiry of Mr. Pakes in the Aug. 12 issue as to what could have been the engineer's reason for altering the feed-pipe arrangement, I should like to submit the following explanation:

The discharge of the feed water as arranged by the predecessor of Mr. Pakes occurred in a fine spray over the water level, thus bringing the water with its largely increased surface in direct contact with the steam. The large difference of temperatures of the water and the steam (I must assume this big difference because there would not be much of a drop in pressure with feed water preheated nearly to the temperature of the boiler) results in a rapid heat transfer from the steam to the feed water and causes a sudden drop in pressure. Yet as soon as the pressure drops, the boiler water will partly



Curves illustrate drop in pressure with different methods of feeding

evaporate and after some time, when the water has accumulated sufficient heat from the furnace, the same condition as before the feeding will be had.

By letting the feed water discharge under the water level, as Mr. Pakes does it now, the fresh water gets heated from the hot boiler water and does not come in contact with the steam. However, a small drop in pressure will take place immediately after starting the feed, but will not be so marked as with the other method of feeding.

The accompanying diagram explains both kinds of feeding. Curve *A* illustrates the drop in pressure with the former method of feeding in a spray above the water level and *B* the usual method of discharging the feed into the boiler water, assuming that the steam demand is constant and that the fuel supply corresponds to the steam demand. The diagram shows that the original pressure will be reached in case *A* earlier than in case *B* although in case *B* there will be a better water circulation. In both cases the point A_3 will be reached about the same time because the transmission of heat from the furnace to the water will not be much different. The better circulation in *B* will be equalized by the greater temperature difference between the boiler water and the furnace in case *A*.

Now in order to answer the question, I have to say that there are two different types of feed-water regulators—one which maintains a constant water level and the other which allows a variation in the water level by retarding the feeding by high steam demand and reverse. In the latter case a more constant steam pressure will be obtained, the boiler working as an accumulator.

It may be that the predecessor of Mr. Pakes intended to equip the boiler with such a feed-water regulator. I see no other reason for changing the discharge pipe.

New Dorp, Staten Island, N. Y. H. COERPER.

Large Oil Engines

I read with interest the extract in *Power*, July 29, of the paper "The Internal Combustion Engine," read at the World Power Conference, London, June 30, 1924, by Prof. Charles E. Lucke.

The last sentence of the second paragraph stated that "in the very large capacities, typical of big central stations, the internal-combustion engine yields to steam or hydraulic turbines because very large internal-combustion engines cannot be built." I first thought I had misread the sentence, and then the thought occurred that Professor Lucke must have been misquoted. But on rereading the extract, I was compelled to believe that the statement was as Professor Lucke had made it. Had he written his paper five years ago, there would be no criticism of that statement. But to make that statement as of the date of June 30, 1924, is certainly misleading and not in accordance with the facts as to the size of internal-combustion engine units being built and successfully operated today. In the semi-Diesel class, I find records of engines being advertised as ranging from 350 up to 500 hp. per unit, and one or two manufacturers have developed six-cylinder units up to 1,000 hp. When it comes to the Diesel class, I have before me the advertisements of several manufacturers who are offering units of from 1,250 to 2,200 hp. There is one company in the United States that makes only large units, namely, machines of 1,950, 2,900 and 3,900 hp. Others offer engines ranging from 20 to 8,000 hp. for all classes of purposes. One user of Diesel engines has over 30,000 hp. in service, ranging in sizes of from 750 to 2,200 hp., eighteen of these being 1,250 hp. and larger.

I believe it is true that the sizes of 2,200 and 2,500 hp. are the largest that have so far been built in America, first, because the inquiring purchaser had the same belief that Professor Lucke expressed and was afraid to risk an order for a larger size. Every engineer familiar with the business knows that the European countries are ahead of America in the sizes and types of internal-combustion engines. As example, in December, 1923, a contract was made for two double-acting engines of 10,000 hp. each by an English firm.

A Danish concern as long ago as April, 1923, advertised that it was in a position to furnish 5,000-kw. Diesel-generator sets with a 15 per cent overload capacity.

I have frequently encountered in prospective purchasers of power plants the idea that the oil engine was good only for small isolated stations, but that a steam plant was the feasible one for the large central stations. The exact opposite is true; the internal-combustion engine in the larger sizes is even more economical than its exact type in the small sizes and will show a greater economy in operating and maintenance costs, over steam central stations.

A. E. PARK.

Memphis, Tenn.

High Steam Pressure in Industrial Plants

In the Sept. 2 issue Mr. Sheehan opens the discussion of the possible benefits of high steam pressures in the industrial plant. He takes the case of a paper mill that has recently installed supposedly modern power-plant equipment, and shows that by raising the steam pressure to 600 lb., the total power costs could be reduced nearly 40 per cent, or from $108,000 to $66,000.

I do not question his thermodynamics, nor do I question his opinion that industrial power-plant design will trend in this direction, but I do believe that the equipment that was installed at this plant is economical for the purpose, and I do not believe that the engineers who were responsible for the design were behind the times, as Mr. Sheehan would lead us to believe.

In the first place, the business of the plant under discussion is making paper. The business of a power company is making power. No one would expect the power company to experiment with paper-making. Then why expect the paper company to experiment with power-making?

No industrial plant having even large uses for power or steam can afford to forget the difference between efficiency and commercial economy. The chief need, in an industrial power plant, is reliability, and while one process may be more efficient than another, it might easily be much more costly in the end because of a sacrifice in reliability. Could the paper mill afford to take a chance on the 600-lb. steam plant?

Mr. Sheehan says that this equipment was installed less than two years ago. Of course it was designed at least a short time before that. He will remember that two years ago, there were no proved results in this country of operation even in central stations at 600 lb. pressure and 200 deg. superheat (a total temperature of nearly 700 deg. F.), and since that time central stations have not rushed madly into these pressure regions. Dr. Jacobus said at the World Power Conference that "The Commonwealth Edison Co. of Chicago was the first to order a 1,200-lb. boiler, but the manufacture of it has been temporarily held up awaiting results of its 600-lb. development."

Since the steam generation will be cut from 30,000 lb. per hour with the present arrangement, to 13,000 lb. per hour with the proposed 600-lb. pressure, Mr. Sheehan wants to replace the three 3,500-sq.ft. boilers with two 2,000-sq.ft. 600-lb. boilers. One of these at 200 per cent rating would carry the load and give a spare boiler. This compares with two boilers at 130 per cent with the third as a spare. In the latter case the plant is well protected, because if one boiler should go down, the other could carry the load, with 260 per cent rating, until the spare boiler could be fired. In the former case the plant would not be protected, because the failure of the only boiler in operation would shut the mill down before the spare could be put on the line. And who can deny that a 600-lb. boiler operating at 200 per cent rating would be less reliable than a 190-lb. boiler operating at 130 per cent? Maintenance would be considerably higher and efficiency somewhat lower. Depreciation would also be considerably higher.

The prime mover suggested is a non-condensing reciprocating engine with a specially designed high-pressure cylinder taking steam at 600 lb. and discharging it into a standard unaflow cylinder at 150 lb. This in turn would exhaust into the driers at 13 lb. back pressure. I doubt if a manufacturer could be found who would build such an engine and give any assurance of reliable service. Also, I doubt if there is a paper-mill owner who would want to stake the day-in-and-day-out operation of his mill on a unit of that type.

Turning again to the calculations of costs, we find the following:

1. It is figured that 48 per cent as much fuel would be burned with the higher pressure. This 48 per cent of the former fuel bill of $79,275 gives $38,052 instead of the $36,069 calculated. The lower efficiency resulting from higher boiler rating would bring this up to around $39,000.

2. The higher depreciation rate and the increased maintenance on 600-lb. equipment operated at higher rates would probably bring the 17 per cent that was allowed to cover these items and interest, insurance, and taxes up to nearly 20 per cent, and 20 per cent of the $136,000 cost would be $27,200 instead of the $23,120 allowed.

3. It is assumed that cutting the fuel consumption in half would reduce the $14,000 boiler-room-labor bill (six firemen, three coal and ash handlers) by a like percentage, giving $7,000. There would still be three coal and ash handlers (one per shift), and whether one fireman per shift would be enough is at least doubtful. The labor bill would still be at least $9,000.

4. Supervision costs for a 600-lb. plant would be increased by at least $2,000 a year, because central-station caliber would be needed for intelligent operation at this high pressure. This increase was not allowed for.

We have now found additional costs of $11,000. Subtracting this from the estimated saving of $41,806, we have left less than $31,000 as the actual net saving.

If Mr. Sheehan wants to figure on some even more attractive possibilities for paper-mill steam and power economy, I suggest that he assume that the paper is being dried in the newly developed vacuum paper drier. This was fully discussed in the Feb. 14, 1924, issue of the *Paper Trade Journal*. The process consists of drying the paper under 28 in. vacuum at about 100 deg. F. This shows large economies in steam consumption. Excess power above that required for steam supply could be generated with Diesel engines. A combination like this would, in my opinion, show far greater savings than the adoption of higher steam pressures, and the development of such a paper drier would be more logically the business of a paper mill.

W. J. RISLEY, JR.,
Manufacturing Department,
The Curtis Publishing Company.
Philadelphia, Pa.

Efficient Power Generation Versus Fuel Economy

In the editorial entitled "Efficient Power Generation Versus Fuel Economy," in the Sept. 9 issue, there is much that appeals to an old timer. "How often, in the days that have gone by" have us old fellows seen a dollar's worth of efficiency expended to save ninety cents worth of material!

In several articles that have appeared in the technical publications recently, the high efficiency of the coal burned has been stressed, but what has it cost to get it? I recall an early experience of one of my former clients, the owner of a paper mill, who wanted additional power. His engine was operated non-condensing, and all the exhaust steam was used for heating and process. Someone came along and told him that by using the exhaust in a low-pressure cylinder he could get an additional 100 hp. The outfit was purchased at an expense of $8,000, and this included a jet condenser. The engine was then operated condensing, while high-pressure steam was used for heating and process. Consequently, the paper mill did not pay and is now closed.

Another case was that of an elevator owner. He was made to believe that by putting in a jet condenser he would save 25 per cent on his fuel bill. In this plant there was an extra-large feed-water heater which raised the temperature of the feed water up to about 205 deg. F. This of course was cut out and water direct from the city mains fed to the boiler, while the water from the condenser was returned to the river.

Now the pity of all this is that most of these bunco schemes are practiced on men of moderate means who think they must employ low-priced help in order to make their business pay, and the question is, What can we do about it? Surely, the article herein referred to is worthy of consideration. W. H. ODELL.

Brooklyn, N. Y.

Recommends Driving Boiler Auxiliaries in the Small Plant from a Common Lineshaft

The editorial, "Bleeder Heating in Isolated Plants" in the Aug. 26 issue prompts me to offer a suggestion that would enable some of the smaller plants to achieve a better heat balance and a more economical installation.

To insure reliability, a duplicate equipment of boiler auxiliaries is essential and in a forced-draft, stoker-fired plant this would mean two feed pumps, two stoker drives and two fans. I have seen instances where the fans and stokers are driven by the same unit, and believe it would be practical to drive all of the boilers auxiliaries from a common lineshaft, using a simple-steam engine and a motor as the driving units.

It is a simple proposition to arrange the auxiliaries so they may be driven from a common lineshaft. Regulation seems to be the obstacle. However, all are in a common service and should be easily synchronized by means of stepped pulleys. Minor variations may be accomplished by a bypass from the feed-water discharge line into the heater or other reservoir of the feed-water system. The feed pump would be of a size capable of supplying sufficient water at the lowest speed of the lineshaft, and assuming a regulation of the lineshaft speed by the requirements for steam, the operator may correct variations of the boiler-water level by adjustment of the boiler-feed-line valves and the bypass valve.

In my opinion stepped pulleys are a practical and simple speed changing mechanism and as a drive, belts are preferable, as a broken one can be quickly replaced by a spare.

When properly installed, a lineshaft is a reliable device and with duplicate driving units, a spare fan and pump are unnecessary, although an injector would be needed to conform to the regulations.

A lineshaft in the boiler room would also permit the engineer to operate a few tools if desired, such as a lathe, pipe threading machine and air compressor and lathe, pipe threading machine and air compressor.

Philadelphia, Pa. T. J. QUINN.

Why Not Tell the Whole Story?

Why is it that when a concern sends out literature accouncing a new tool, a new device or some new material, it does not at the same time give either the net price or the list price with discounts? Much initial business that in turn might lead to further trade is lost by the failure to include this necessary information.

It often happens that an executive, on reading the literature announcing the new article, will become interested, as he thinks that it may be something that he wants. He wishes to get an idea of the cost, but he usually finds that this information is lacking. He is too busy to take the time to dictate a letter asking for the data, and even if he does so, by the time that the reply comes in, his interest has lessened or the matter has been entirely forgotten; and thus a possible sale has been lost.

Sometimes, to aggravate matters, the reply, instead of giving the desired information, will state that the inquiry has been turned over to Messrs. So-and-So, who are the authorized agents and who will doubtless advise. This means still further delay. If concerns would only tell the whole story including the cost at the start, both the seller and the buyer would profit thereby.

Lawrence, Mass. A. J. CALHOUN.

Why Should the Smaller Pump Give Better Results?

Referring to the inquiry of Mr. Pakes in the Aug. 26 issue, "Why Should the Smaller Pump Give Better Results?" it is difficult to answer this intelligently without having complete data as to the size of suction piping and capacity delivered by the fire engines. It appears that attempts were being made to handle more water than the fire engine was capable of supplying. This accounted for a good fire stream when only one 1¼-in. nozzle was used, but when two nozzles were attached, their combined capacity was greater than that of the engine. This resulted in a fluctuating stream with a large amount of air present.

The same thing holds true for the duplex pump, but owing to the fact that the duplex pump had greater capacity than the centrifugal, it handled more air and resulted in a poorer fire stream. A common cause of this trouble is too small a suction line for the capacity of the fire engine, thus causing a high suction lift. Whether or not this condition existed in this particular case, depends on where the suction readings were taken, as the readings given appear reasonable.

New York City. W. S. KOITHAN.

QUESTIONS AND ANSWERS

Conducted by Franklin VanWinkle

Standing of Governor After Increasing Compression

After setting the valves of our Corliss engine to obtain more compression, the governor seems to stand higher when the engine has about the same load. Is this not because with the change of valve setting the engine takes less steam? *G. E. H.*

The valve setting may have resulted in requirement of less steam per horsepower-hour but the improvement could not be inferred from observing the position of the governor. Earlier compression would result in less waste of steam from the boiler for filling the cylinder clearance spaces, but for development of the same power the cutoff would need to be later to compensate the greater back pressure acting on the piston. Hence if the governor stood higher after the compression had been increased it must have been due to less load on the engine, rather than improvement of the economy.

Use of Blowoff

What is the best time for blowing off a boiler that is in daily use? *P. R.*

The best conditions for use of a blowoff are likely to be present when the boiler water has been free from agitation for a considerable time, as for example in the morning, just prior to starting up the fire. When the boiler is in regular operation the circulation distributes particles of mud and other solids through the whole of the water and if the blowoff is opened under this condition, only that part of the solid matter is carried off that is contained in the bulk of water discharged. When the boiler has been standing idle for a time, most of the suspended matter settles towards the bottom until it is deposited on the lower surfaces or floats close to them in a thin fluid paste. If the blowoff valves are then opened before starting up the draft and circulation, much of the solid matter will be discharged with the blowoff water.

Injection Water for Vacuum Heating

In an exhaust-steam heating system with a vacuum pump on the return, is injection of water into the pump necessary for operation of the heating system? *A. V. M*

The purpose of a vacuum pump is to take care of the condensation and reduce the pressure in the main return to induce circulation of steam in the heating system. Some reduction of pressure would result from operating the pump without injection of cold water, but the principal reduction of pressure results from condensation of the steam in the system itself and removal of air and uncondensable gases and water by the vacuum pump. When the steam of the system is not all condensed in the piping system, or when the condensation delivered to the pump is of high enough temperature to burst into steam at the reduced pressure in the pump, then to maintain the reduction of pressure it becomes necessary to condense the steam by injection of cold water. Although there may be some reduction of pressure by operation of the pump without use of injection water, a small quantity of steam presented to the pump, or formed from hot water delivered to the pump, precludes formation of a better vacuum than the pressure corresponding with the temperature. In a well-designed and properly operated vacuum heating system, the back pressure of the returns is kept low enough for satisfactory circulation in the heating system by removing the air, steam and water at their temperature as presented to the pump. When a better vacuum is required, it becomes necessary to speed up the pump or inject a small quantity of cooling water to lower the temperature, or both.

Computing Pump Capacity

What is the rule or formula for computing the capacity of a pump? *F. G. S.*

The theoretical capacity of a single, double acting pump can be calculated by the formula,

$$D = \frac{a \times P \times 12}{231}$$

Where

D = displacement of one double-acting piston or plunger, in U. S. gallons per min.,
a = area of piston or plunger in square inches,
d = diameter of piston or plunger in inches,
P = piston speed in feet per min.

Where D is the displacement of one double-acting piston or plunger pump in "Imperial" gallons the formula would be

$$D = \frac{a \times P \times 12}{277}$$

For a single, single-acting pump divide D by 2;
For a duplex double acting pump multiply D by 2;
For a triplex, single acting pump multiply D by 1½;
For a triplex, double acting pump multiply D by 3.

From the displacement of the piston or plunger the displacement of the piston rod must be deducted. In most cases this extends through the inboard end of the pump cylinder and is attached to one end of the piston or plunger. It then forms a single acting plunger whose displacement can be calculated by the formula. To find the actual capacity or delivery the slip must be deducted from the displacement and for a new pump a slip of 3 per cent should be assumed.

Cutting of Valves and Seats

What causes the disks and seats of steam globe valves to become cut sooner when the valves are used partly open than when used fully open? J. L. L.

The abrasive action of the steam and entrained water is greater the higher the velocity of flow. In cases where partly closing of a valve results in reduction of the pressure on the discharge side, the higher velocity due to a greater difference of pressure results in cutting the valve-disk and seat, from greater abrasive action of the steam. For the same initial and same drop of pressure, the cutting action is no faster for a valve only cracked off its seat than for a valve wide open, because the steam sweeps over the surfaces with the same velocity in each case.

Cooling Effect of Fresh Coal

Is the quenching effect of fresh coal when put on a fire any greater than abstraction of heat necessary to raise the fresh fuel to the required temperature for ignition? R. D.

When a fresh charge of coal is first spread over a hot fuel bed, the coal is heated up rapidly and part of the combustible is distilled off shortly after the coal reaches the fuel bed. This distillation is a cooling process and tends to hold the temperature down. The highest temperatures are not actually attained by an individual coal particle until its volatile is distilled off. The distilled volatile combustible is carried into the combuston space where it is more or less completely burned, thereby raising the temperature of the combustion space.

Equalizing Cutoffs of Corliss Engine

How is equalization of cutoffs obtained on a Corliss engine without assistance of an indicator? S. M. A.

Block up the governor half way in the slot to determine whether the reach rod lever stands at about 90 deg. with a line drawn midway between the reach rods. Place the engine on a center and make a mark on the crosshead to correspond with a mark made on the guide. Then place the crosshead and piston at about $\frac{1}{4}$ of the stroke and make another mark on the guide to correspond with the mark on the crosshead and gradually block up the governor until the steam valve on the same end of the stroke is just tripped by the cam. Next turn the engine over to the other center, make a mark on the guide to correspond with the mark on the crosshead and place the crosshead at the same fraction of stroke as previously employed by obtaining the same distance between marks made on the guide, to represent the fraction of stroke taken from the other end of the cylinder. Then lengthen or shorten the reach rod as may be necessary to just trip the steam valve on the same end.

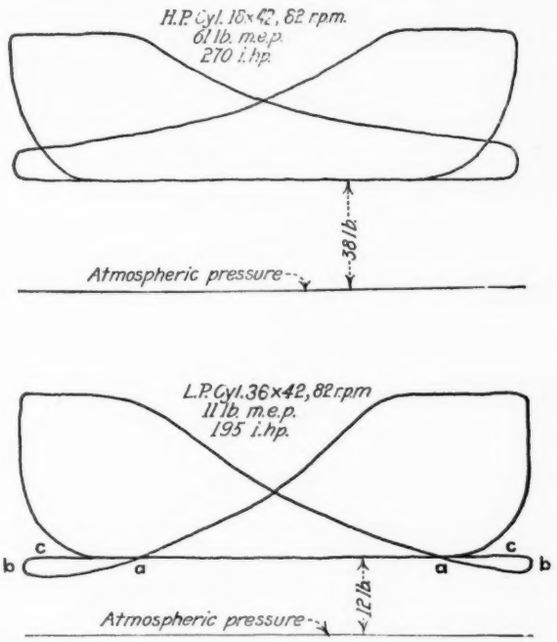
If there is a single reach rod from the governor that is connected to the crank end valve, and the valves are connected by a link rod, the first setting of the engine on center and adjustment of main reach rod and valve should be made on the crank end. The second setting of the crosshead should be on the head end of the stroke and adjustment of the cutoff made on the link rod from the crank end valve to the head end valve.

Equalization of cutoffs will thus be obtained for the fraction of stroke that was taken, but on account of variation of angularity of the connections, for different positions of the governor, precisely the same quality of cutoffs will not be obtained for loads requiring cutoff at other fractions of the stroke. If it is desired to obtain a closer approximation to equal cutoffs for the average load, the governor should be blocked to the average running position and then finding what fraction or stroke the valve is tripped from one end, the same fraction of stroke can be employed for adjusting the reach rod to the valve of the other end.

Back Pressure in Compound Engine

Our 14"×36"×42" compound engine, formerly operated condensing, has been changed to operate noncondensing to supply exhaust for heating that requires 10 to 15 lb. gage pressure. Indicator diagrams now obtained are similar to those shown by the sketch, giving 61 lb. m.e.p. for the high-pressure cylinder and 11 lb. m.e.p. for the low-pressure 11 cylinder, when the diagrams are measured in the usual manner. As the back pressure for the heating amounts to 1 lb. more than the m.e.p., is operation of the low-pressure cylinder thereby a drag on the hp. cylinder? R. G.

The m.e.p. of each cylinder is the average of difference of pressure during the forward and backward strokes as shown by the diagrams made by the indicator, and



Sketch of indicator diagrams from compound engine exhausting against pressure of supply to heating system

in computing the power no further account is taken of the value of the back pressure. In measuring the l.p. diagrams with a planimeter, the areas of the loops *abca*, are to be regarded as negative, because during the forward stroke *a* to *b* on each diagram, the forward pressure is less than the backward pressure. This is the only reduction that is to be made. As 11 lb. m.e.p. is the average net pressure over and above back pressure acting on the piston of the l.p. cylinder, in place of being a drag, the l.p. cylinder contributes 195 i. hp. and the power developed is 270 i. hp. developed in the h.p. cylinder, plus 195 i. hp. developed in the l.p. cylinder, or a total of 465 i. hp.

Recent Publications

The Specific Heat of Gases. By J. B. Partington and W. G. Shilling. Published by Ernest Benn, Ltd., 8 Bouverie Street, E. C. 4, London, England, 1924. Cloth; 6x9 in.; 252 pages. Price, 30 shillings.

This is a highly technical book written for the expert who is familiar with mathematical physics and chemistry. Its purpose is to give a critical summary of the existing data on specific heats as a guide to those who need such information in the design or testing of such industrial equipment as blast furnaces, boilers and internal-combustion engines.

The Diesel Engine. By C. J. Wells and A. J. Wallis-Taylor. Published by D. Van Nostrand Co., New York, and Crosby Lockwood & Sons, London. Cloth; 5½x8¾; in.; 334 pages; 133 illustrations. Price, $5.

In reviewing any book, the reviewer must keep in mind the public to which the work is addressed. If, as the authors stated in the preface, this volume was written for the benefit of draftsmen, students and the like, they have failed in their efforts for there is a well-nigh total absence of data as to dimensions of engine details and methods of computation. Only in the case of air compressors have the authors attempted to develop the basic principles, and here it must be acknowledged that the methods, while applying to low-pressure compressors, are not used by designers of Diesel compressors. Those more important details of engine design, such as fuel valves, piston, etc., are treated in less than a sketchy manner. In addition, the tests, etc., are on very small engines of ancient vintage and by no means represent current practice. The space devoted to the subject of the temperature-entropy diagram is the only praiseworthy chapter in the volume. It is most unfortunate that the design of the oil engine has received such scant attention since Supino's notable work, although the more practical operating point of view has been amply exploited. It must be confessed that the volume under review fails to deal extensively with either the design or the operation of the Diesel.

Principles of Business English. By T. H. Bailey Whipple. Published by the Westinghouse Night School Press, East Pittsburgh, Pa. Cloth, 6¼x9¼ in.; 182 pages.

Any attempt to improve business English should be welcomed by American business. Business letters are peculiarly subject to the phrase mania that is so apparent in American speech, literature and correspondence. The ready response of the American public to catch phrases tends to the practice of conveying a meaning without any mental effort or search for an appropriate word. This tendency to impress by catch phrases is rarely found elsewhere than in America. "Some Pumpkins!," "sure!," "fine and dandy!," serve in conversation like, "yours received and contents noted," in the business letter to convey information—but what poverty of language and limited vocabulary! The book is well arranged for quick reference for misused words and phrases and has chapters that should prove helpful to beginners who are making their first efforts at writing for publicity or making out their first report. Appendix "C," "Questions and Answers on Business Writing," by Edward Hall Gardner, should also prove most helpful.

Statistical Research in Engineering and Industry (Grosszahlforschung). By Dr. K. Daeves. Published in German by Stahleisen, Duesseldorf, Germany; Paper, 7½x11 in.; 29 pages; 40 illustrations; 19 tabulations. Price, 65 cents.

This book is an interesting discussion on probability and chance as applied to the solution of many problems arising in the execution of process work, in predetermining operating results and in checking the performance of labor and machinery. It is based on many years of practical experience with statistics in the industries, by the author, and enumerates many examples relating to temperature variations, gas analysis, composition of materials, distribution of carbon in steels, furnace conditions, boiler and furnace performance and other important operations. It suggests the more extensive use of graphic presentations and shows how these may be applied to show operating characteristics, correlation of observations and expected results in many processes. The book will be useful to executives and all those who are interested in obtaining a helpful guide in directing important operations from both a technical and a commercial angle.

Applied Electricity for Practical Men. By Arthur J. Rowland. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City, 1924. Cloth; 7x5 in.; 443 pages; 366 illustrations. Price, $2.50.

This is the second edition of this book and has been revised to conform with the changes in application of electrical and magnetic principles since the first edition was published in 1916. This edition, as with the earlier one, is intended as a textbook for practical electrical workers who expect to make direct application of the principles given them in the classroom to their daily work with commercial circuits and machinery. The scope of the work has been confined to those subjects that apply to power and lighting circuits and machinery. Such subjects as radio, telephony and telegraphy have been omitted so as to allow greater treatment of those subjects in which the practical electrical worker is directly interested. It is written wholly from the view point of the one who installs and operates electric circuits and apparatus. When mathematics has been used, it is applied to the simple practical problems that are necessary for an understanding of the work the electrician is doing.

Both direct-current and alternating current motors and generators are treated of. Rotary converters, mercury-rectifiers, static and synchronous condensers for power-factor correction, transformers, and electric lights are among the other subjects covered. Although the book is intended primarily for a text in industrial schools, it has much to recommend it to those outside of these schools who wish to obtain a knowledge of the elementary principles of electrical machinery and circuits.

Engineering in American Industry; Development of Industry in These United States During One Hundred and Twenty Years. By Conrad Newton Lauer, General Manager of Day & Zimmerman, Inc., Philadelphia. Published by McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City, 1924. Cloth; 9½x12 in.; 96 pages; illustrated. Price, $2.50.

A lecture given before the students of Princeton University, Dec. 12, 1923, under the Cyrus Fogg Brackett Lectureship in Applied Engineering Technology is here presented in book form. The history is cleverly told with the interest hung around two heroes; one Zebedee Comly, a farmer in Virginia in 1803, 120 years ago, whose need of a new plow and his troubles in obtaining it are contrasted with hero number two, who is Zebedee Comly III, a farm proprietor in South Dakota in the year 1923, the grandson of the former hero, and how his need of a plow was met with our now customary speed. The illustrations of the ancient power devices are entertaining and bring the inevitable smile which old-fashioned things always produce. The "De Witt Clinton" locomotive; the whaling bark "Greyhound"; the first transatlantic steamship "The Savannah" (1819); Philadelphia's water-supply works of 1800, its engine which was built at the Soho Works of Nicholas J. Roosevelt, near Newark, and the wooden pipes used for the system; the Centennial Corliss steam engine; the quadruplex telegraphy of 1884; a telephone exchange of 1879; the gas works of 1884; the cable car of 1876, which resembles our present "Toonerville Trolley That Meets All Trains," of comic fame; the great power house in Baltimore (1800) and other interesting pictures beside numerous production charts of the different industries for those early years and on down to the present time, make this volume worth possessing by all those interested in the progress of engineering and power.

American Standard Screw Threads for Bolts, Machine Screws, Nuts and Commercially Tapped Holes. Approved by the American Engineering Standards Committee, May, 1924. Sponsor societies are Society of Automotive Engineers and the A.S.M.E. This standard can be purchased from the American Society of Mechanical Engineers, 29 West 39th St., New York City, by members of the A.S.M.E. for 45 cents and for 50 cents by non-members.

The Pendleton Centralized Control for Heating Systems*

HEATING systems are ordinarily designed to meet the minimum outdoor temperature, with the result that considerable regulation is necessary in order to secure proper operation at warmer temperatures. Central-station heating plants find it desirable that their customers use steam economically.

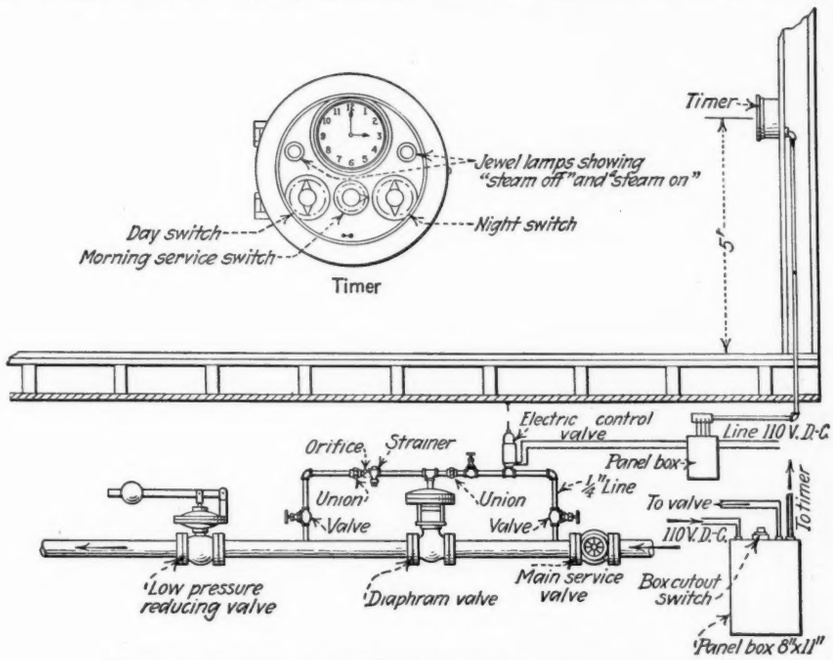
This control equipment, which has been given a trial during the last heating season, is designed to supply a convenient means of admitting an economical amount of steam for heating purposes. Where steam is sold at a sliding scale, that saved at the low step prices can often be disposed of at a higher rate to other consumers. It is therefore desirable to reduce steam consumption to a justifiable minimum.

Several years ago a system was devised by F. E. Pendleton, Chief Engineer of the New York Steam Corp., and placed in operation in a number of apartment houses, hotels and office buildings, for the purpose of regulating steam supply. This is not intended to maintain a constant temperature within the building, but to supply an amount of steam suitable to the conditions in accordance with outside temperature.

It is not looked upon as being a means of saving practically all the steam that would otherwise be wasted, but rather as a convenient device which conserves a large part of such steam. This makes its installation economically desirable from the point of view of the consumer and reduces steam consumption to such an extent as to be attractive to the central station.

The entering steam is controlled by means of a master clock which in turn causes the supply to be shut off and again turned on at definite intervals during the day and night. The cooling and heating intervals are regulated by switches placed on the clock, which may be set by the tenant in accordance with outside temperature conditions. The supply at night is ordinarily restricted to a much greater extent than that allowed in the daytime.

The general arrangement of the device is indicated in the figure. The master clock is placed at any convenient point, such as the office of the superintendent of the building. It contains two hands, one for day and one for night service, in the lower part, which may be set as indicated on the chart for various conditions of outside temperature.



Master-control for steam-heating equipment may be installed at any desired point in a building

In addition there is a morning switch which may be utilized for throwing the entire supply of steam into the system, regardless of settings of the others, and which is useful for purposes of heating up. Two jewel lamps are provided, a red one indicating steam on and a green, indicating steam off. This clock contains the timer mechanism which electrically controls the admission and cutting off of the steam.

Most of the systems operate from 110-volt direct-current circuits with a special control circuit of twelve volts, obtained between the main circuit and the ground. A spring loaded solenoid pilot valve, piped with ¼-in. brass pipe is operated from the twelve-volt circuit of the timing device. This admits high-pressure steam, which is supplied from the main service at 100-lb. gage, to the diaphragm chamber of the main control valve.

After passing through the main control valve, the steam from the main service is throttled by a reducing valve to the low pressure as required. An orifice on this ¼-in. line is also supplied which allows a continuous flow of steam into the main system, when the control valve is turned off. This is a 1/32 in. orifice admitting about 4 or 5 lb. of steam per hour in order to keep the main service warm. A solenoid control valve would be advantageous, in place of the pilot and diaphragm valves, particularly where alternating current only is available. This feature is being developed.

The operation of the equipment is to interrupt the normal steam supply. Any failure of electric circuit for any reason permits steam to flow to the radiation, the same as though equipment were not installed. Completion of the twelve-volt circuit at the timer, closes a relay switch in the panel box which closes the 110-volt circuit to solenoid pilot valve. The latter opens and admits high-pressure steam to diaphragm chamber of the service-reducing valve and shuts off the supply to the building.

Closure of the relay switch also produces through auxiliary contact, a closure of the twelve-volt circuit to a green jewel lamp in the timer, indicating "Steam Off." Breaking of the twelve-volt circuit at the timer opens a relay switch in the panel box, which permits the spring-loaded solenoid pilot valve to close, shuting off high pressure from the diaphragm chamber, thus permitting the service-reducing valve to open and resume delivery of steam to radiation. The opening of the relay switch breaks an auxiliary circuit to the green jewel lamp and closes an auxiliary circuit to the red jewel lamp in the timer, indicating "Steam On."

The installation of the equipment is made at an average cost of from $50 to $100, depending of course, upon the distance of timer from panel box and the amount of wiring to be done. In New York City the ownership of the equipment is retained by the company; the actual cost of installation is charged to the consumer, together with a rental charge of $25 per annum for the equipment.

*Abstract of a paper, "Steam Service Control," by William J. Baldwin, Jr., read at the recent Spring convention of the National District Heating Association.

Use of Streets

That, excepting as to the natural rights of abutting property owners, a city has no power to authorize the use of streets and sidewalks for private purposes disconnected from public travel, etc., is a proposition of law that has been laid down by the courts frequently.

A concrete example is afforded by the recent decision of the Louisiana Supreme Court in the case of Viering vs. N. K. Fairbanks Co., 100 Southern Reporter, 729. It was there decided that a municipality could not validly empower a manufacturing company to erect and maintain on the sidewalk in front of plaintiff's premises posts supporting guy wires holding a smoke-stack in position.

But it was decided that since plaintiff had permitted the company to maintain for thirty years such posts on his own property, a vested right to maintain them was acquired.

U. S. Department of Commerce Achievements Noteworthy

Business Indebted to It for Facts, Figures and Advice

AN AGENCY with a reputation of being engaged largely in statistical and other stereotyped tasks the Department of Commerce, within the last three years, gradually has taken on vitality and momentum until now it is roaring along like a great motor and has become a vivid, powerful and indispensable force in American business.

Unquestionably Mr. Hoover's greatest accomplishment as the Secretary of Commerce, and the one which promises greatest return to the public, is his promotion of constructive self-government in industry. He has shown conclusively how these voluntary forces can bring American industry to a new high plane of efficiency. Codes of ethics have been established in many lines of business. Many others are in the making. Practices that are unfair to the public and to others in the same line of endeavor are being specifically listed and condemned. The way has been pointed out for industry and it is lifting its own standards and taking steps to see that they are maintained.

Leadership in Business Encouraged

In the matter of trade promotion, leadership is vested in those engaged in the business concerned. No step is taken until it is established that the trade wants it and needs it. That this policy is bearing fruit is shown strikingly by the fact that new business secured during the last fiscal year, as a result of suggestion or help from the Bureau of Foreign and Domestic Commerce, totaled $529,000,000. In this work the Bureau expended $2,600,000. This is a return to the taxpayer of 17,600 per cent on the investment.

That this service of the Bureau of Foreign and Domestic Commerce is filling a need is indicated by the fact that inquiries are received at the rate of 7,000 per day. This is ten times the average of three years ago and represents an increase of 100 per cent over the rate of a year ago, despite some very effective stops to reduce at the source the number of inquiries.

One of the main reasons for the remarkable expansion in the use of this Bureau unquestionably was the reorganization under which commodity divisions were set up. This form of organization is essential if leadership is to come from industry.

The new Division of Domestic Commerce is carrying into practice the ideas of business men in the effort to reduce the wastes and costs of distribution. Research is being conducted on various phases of retail merchandising.

In the effort to insure lowest possible prices to the consumers and to increase the returns to the producers, the Division of Simplified Practice, set up within the Department, has been doing result-getting work in eliminating excess variety. It is taking many other steps to eliminate waste in industry.

Recognizing the far-reaching benefits of bringing ocean-going bottoms to the ports of the Great Lakes, thereby reducing the transportation charge against the products resulting from the labor of forty million people, Secretary Hoover proposed the creation of the St. Lawrence Commission. President Coolidge approved the recommendation and appointed Mr. Hoover as the Commission's chairman. Under his auspices essential economic studies now are being made which will have an important bearing on the project which, in addition to the waterway involves the harnessing of 2,000,000 hp. of water power, in an area where industrial development cannot expand much further until this power is made available.

Much has been done in an attempt to call attention to the fact that electrical interconnection in the Northeast, the principal industrial section of the country, is not keeping pace with the best practice elsewhere. Studies have been made and maps prepared which emphasize again the need for interconnection, the construction of large steam central stations at strategic points, and the development of more water power. As a result of these studies the conclusion was reached that it would be possible to reduce coal consumption in the area by more than 50,000,000 tons annually, power could be made available at lower rates, the factor of reliability could be improved, electrification of railroads could be made feasible, and power could be made available on farms.

Statistics an Aid to Business

One of the great assets of the American business man is the statistical service furnished by the Bureau of the Census. During the last three years there has been rapid expansion in the production of current figures which make available to all interested an accurate picture of the conditions under which operations are being conducted. Facts gathered by 116 trade associations, fifty-five Government organizations and a large number of trade periodicals are compiled in highly serviceable form in the monthly publication *Survey of Current Business*.

Under Mr. Hoover's direction the Bureau of Standards, the greatest physical laboratory in the world, has taken on new life. It has made a large number of technical studies which are of great value in making possible improved methods of production. It has increased industrial efficiency through the working out of better codes. Better utilization of raw materials has resulted from its researches. Mention of some of the other activities of the Bureau gives an idea of the practical character of its studies: corrosion of pipes and metal buried in the ground; reduction of the amount of material used unnecessarily in building construction; measurements of thermal conductivity; the use of American clays in paper making; standardization of gages; corrosion of metals; and studies of high speed tool steels.

Development of Water Power Projects in Pennsylvania

Since January 1, 1923, applications for the incorporation of companies involving the developing of 900,000 hp. have been before the Water and Power Resources Board of Pennsylvania. Applications for companies involving 390,000 hp. have been approved and of the remaining applications 9 of the proposed plants involving 300,000 hp. are on the Delaware River. Negotiations for a treaty with the states of New York and New Jersey are now under way and it is hoped that such a treaty will be approved by the states involved, and that this will permit the development of power in the Delaware. There has recently been submitted an application for the incorporation of a company for the development of 60,000 hp.

A canvass of the state, made by the Water Supply Commission, 17 years ago, showed there were aboout 1,260 water power plants in the state, most of which were flour and feed mills. A report on the water power of the state in 1914 shows there were 70 hydro-electric plants with a hydraulic capacity of 173,000 hp. Two plants, however, the Holtwood Plant of the Pennsylvania Water and Power Co. and the York Haven Plant, accounted for about 143,000 hp., leaving 30,000 hp. for the other 68 plants. At the present time there are 70 hydro-electric plants, one of those existing in 1914 having been abandoned and a new one built; these plants develop about 227,000 horse power.

The Piney Project of the Clarion River Power Co. recently placed in operation is on the Clarion River near the borough of Clarion, at a point where the drainage area is 980 sq. miles. The plans for this project provide for the ultimate installation of 4 units of 11,000 hp. each, two of these are now installed. The reservoir created by this dam is 12 miles long.

Proposed Water Power Projects

The Wallenpaupack project of the Pennsylvania Power and Light Co. is now under construction in Pike and Wayne Counties on Wallenpaupack Creek. The gross head developed on this project is about 370 ft., the water being taken from the dam to the power house through a conduit 14 ft. in diameter and about 11,000 ft. long. Two units of 28,500 hp. each will be installed in the power house. At the present time there are about 600 men working on this project.

The Conowingo project of the Susquehanna Water Power Co. will be built at Conowingo, Maryland, where the drainage area of the Susquehanna River is about 27,000 sq. miles. The dam will have a maximum height of 110 ft. and will be 3,240 ft. long. In the power house, at the west end of this dam, will be installed ultimately 10 units of 36,000 hp. each. It is proposed to install 6 of these units when the power house is built.

The development of Shohola Creek in Pike County involves the construction of 2 plants developing 21,500 hp., while the development of the Juniata River below Newport will be for 10,000 horse power.

Rensselaer Polytechnic Institute Holds Its Centenary Celebration

Distinguished Engineers and Educators Were Given Honorary Degrees

LEADERS in science and engineering in America and the world took part in the celebration of the hundredth birthday of the oldest college of science and engineering in any English speaking country in the world, the Rensselaer Polytechnic Institute, Troy, N. Y., on Oct. 3-4. More than two hundred and fifty representatives of the leading educational institutions and scientific societies participated in the procession across the campus to the great hall of the State Armory where the addresses were made before a large audience which included 3,000 alumni from all parts of the United States, Canada and Latin America.

The principal addresses were made by:

Secretary of Commerce Hoover.

Sir Charles L. Morgan, president of the Institution of Civil Engineers of Great Britain.

Henry Abraham, past president of the Society of Electrical Engineers of France.

Luigi Luiggi, president of the Society of Civil Engineers of Italy.

Arthur Surveyer, president of the Engineering Institute of Canada.

C. E. Grunsky, president of the American Society of Civil Engineers.

Fred R. Low, president, American Society of Mechanical Engineers.

William Kelly, president, American Institute of Mining and Metallurgical Engineers.

Farley Osgood, president of the American Institute of Electrical Engineers.

Prof. Albert A. Michelson, president of the National Academy of Sciences.

Presidents Angell of Yale, Birge of Wisconsin, and Stratton of the Massachusetts Institute of Technology.

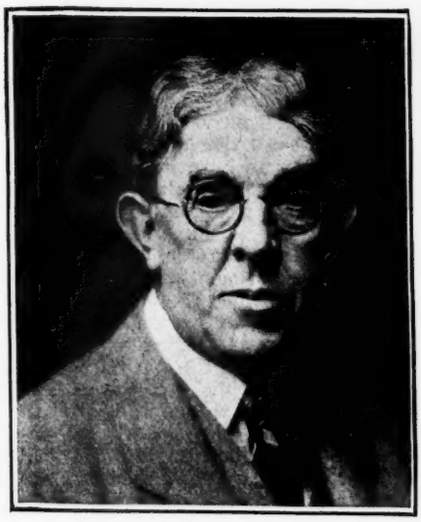
At a banquet, at which about a thousand were present, the addresses were made by President Livingston Farrand of Cornell, H. W. Jervey, dean of the Law School of Columbia University, and J. H. Odell, of Wilmington, Del. Honorary degrees of Doctor of Engineering were conferred on the heads of the engineering societies who spoke, and Doctor of Philosophy upon the presidents of the universities and Dr. Michelson.

The speakers contented themselves in the main in bringing from their respective institutions or societies greeting at the successful completion of a hundred years of service. One thought ran through most of the addresses, however—a tribute to the founders and executives of the Institute for the realization of the need for applying the facts of pure science to the actualities of life. It was recognized that Rensselaer was the first of the now many engineering schools and that the idea of its founder, though much amplified even in the early years after the founding, was fundamentally to break with the classic idea of science and to make it a practical aid in life.

Secretary Hoover voiced this well when he said: "The realization that education of a body of men in pure science and in the humanities combined at the same time with a knowledge of the mechanic arts as the vital bridge over which science could alone become the implement of man is the notable contribution of this institution. From her sons and her influence has grown that great spread of engineering schools in our country and that army of half a million trained engineers who have builded our transportation, our communications, and our industries. Without this link for the skilled application of science to need, science itself would have to a large degree remained locked up in our laboratories and libraries."

Train Students to Be Men

President Farrand, of Cornell, voiced a warning against too intensive technical training in the technical schools. Drawing an analogy from his own profession, that of medicine, Dr. Farrand said that the engineering school today must not forget that after all it is training men as well as engineers, and that the great business of living requires a broad preparation, quite as broad as the business of being an engineer. This thought was echoed in the remarks of President Angell of Yale and Birge of Wisconsin, though the latter directed most of his attention to bringing greetings from the great land grant schools which rose nearly half a century after Rensselaer was founded. Dr. Michelson took a different view in his speech, in that, while recognizing the value of applied science and the contributions that the engineer has made to the world, he pled for a greater recognition of the pure sciences whose inadequate monetary return is discouraging in the extreme.



Palmer C. Ricketts, president of Rensselaer Polytechnic Institute

Several commemorative tablets were unveiled at different parts of the campus and an elaborate historical pageant, arranged on a set of stages on the face of a rocky eminence, along one side of the athletic field, in which 500 persons or more were included in the cast, depicting the outstanding events of the Institute and the development of science, was given on the evenings of Oct. 3 and 4.

In Scene I, the founding of the School in 1824 by Stephen Van Rensselaer, the large landholder, whose vision of "qualifying teachers for instructing sons and daughters of farmers and

Russell Sage Laboratory, Rensselaer Polytechnic Institute

mechanics, in the application of experimental chemistry, philosophy and natural history to agriculture, domestic economy, the arts and manufacturers," was shown. This vision was obtained largely through the influence of Amos Eaton, who was born during the year of the American Revolution, and who was one of the first to give lectures on scientific subjects in America. They arrived at the decision to make this important experiment in education, so Rensselaer provided the money and became "patroon" to start a school "for the application of science to the common purposes of life," and the announcement establishing the Rensselaer School where the "Exercises of the Day Class, for six hours in each day, except Sunday, shall consist of experiments in chemistry, performed by themselves and in giving explanations, or the rationale of the experiments; and they shall undergo daily examinations and alternately become examiners themselves," was made in 1824. Professor Eaton became the first head of the school, which soon outgrew its early intention.

Scene II, depicted the excursions on the Erie Canal in 1826 for the study of botany and geology. This field study was a great innovation in those days. It was during the period covered by this scene that other departments of engineering and technology were started.

Scene III, took up the re-organization of the School under B. Franklin Greene in 1849-50 and the re-naming of it as the Rensselaer Polytechnic Institute. The final triumph at the end of a century was also given. The pagent was delightful and the costuming and coloring most beautiful.

The present director, Palmer C. Ricketts, whose portrait is included in this article became the head of the Institute in 1892. He was graduated from Rensselaer in 1875 and became an assistant instructor in mathematics the same year. In 1882 he became an assistant professor and three years later was made professor of mechanics. In addition to his activities as director of the Institute for thirty-two years, he has been a practicing consulting engineer, an author, and a lively participant in the municipal activities of the city of Troy. A distinguished visitor was W. H. Patchell, president of the Institution of Mechanical Engineers, England.

Appeals to Northwest to Use Mississippi River

In a newspaper interview Senator Broussard of Louisiana has appealed to the Northwest asking that the weight of its influence be put behind an adequate Lakes-to-Gulf waterway. Without committing himself, either for or against the St. Lawrence waterway, the Louisiana Senator contends that it is very apparent a long delay is facing the St. Lawrence project because of the international questions involved. He says the people of the Northwest cannot wait for a generation on cheap transportation and urges them to take cognizance of the existing outlet to the Gulf which lies entirely within the United States. With the proper expenditure of reasonable amounts, he says, deep water can be extended to Chicago. He suggests as well the extension of the barge service to the upper Mississippi and to the Missouri and the Arkansas.

The Senator's inquiry into the matter in government quarters leads him to believe that the character of objections now being raised by Canada bid fair to delay the St. Lawrence project for an indefinite period. Since the prosperity of the Northwest depends to a considerable extent on the availability of cheap transportation, he urges the people of that section to consider a tidewater outlet by way of the Mississippi.

Government Needs Dynamo Tender

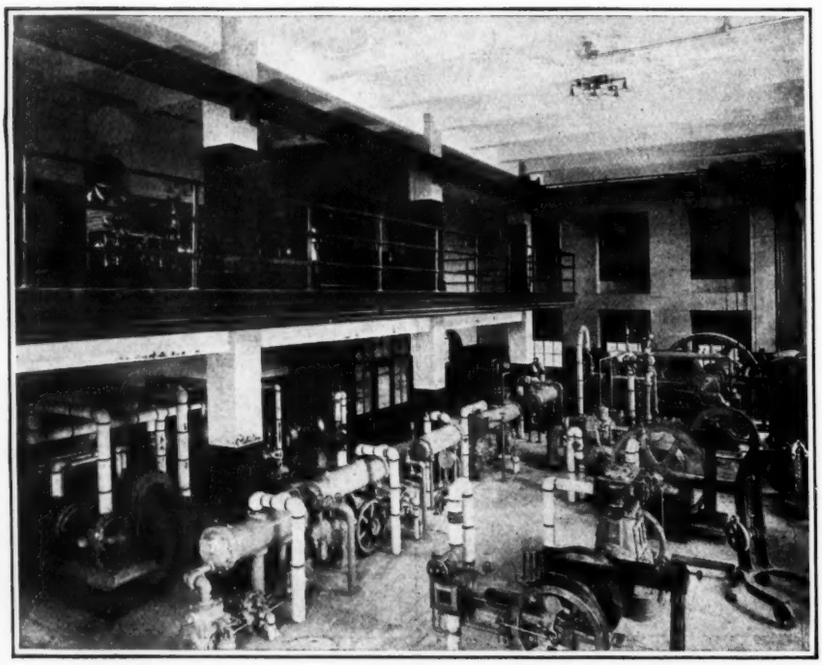
The United States Civil Service Commission announces an open competitive examination for dynamo tender. The examination is to fill a vacancy in the Post Office Department, at an entrance salary of $1,140 a year with advancement in pay up to $1,500 a year.

Applicants must have had at least one year's experience as dynamo tender, substation operator, or in a similar position. The duties are to operate and maintain electrical apparatus, with its starting and switching equipment, to be responsible for the proper oiling and cleaning of the equipment, to assist in minor repairs, record operating data, and other work as required.

Competitors will be rated on physical ability, training and experience. Receipt of applications will close November 11.

A Large Refuse Power Plant

A beginning with what is claimed to be the largest refuse power plant in the world was made recently at Glasgow. The Helen Street plant, which will occupy about 15½ acres, is to be designed and constructed on entirely new principles by Heenan and Froude, Limited, of Worcester and Manchester. It will deal with the whole of the rubbish from the south side of the city, and the heat from the destructor will be used to raise steam for driving two 5,000-kilowatt turbo-alternators, a third set being installed for stand-by purposes. The current generated will be sold to the Electricity Department. Heenan and Froude, it is understood, have given particular attention to the mechanical feeding of the refuse to the destructor and the mechanical clinkering of the furnaces, both of which operations are carried out in such a way that a constant head of steam is maintained at the boilers. The plant is designed to run continuously throughout the twenty-four hours, and it is estimated that the yearly output of current will approximate to 58,000,000 units, of which 50,000,000 will be sold to the Electricity Department, and the remainder utilized in the works for the running and lighting of the plant and for charging a fleet of fast electric vehicles, which are to be employed in transporting the débris to the destructor plant. There is expected to be a large demand for the clinker for road-making and building purposes. Glasgow Corporation is to be congratulated on the lead it is giving towards obtaining an economical solution of the problem of disposal of city refuse. At this stage, it is not possible to give further details of the installation, but in view of the long and successful experience of the designers of the plant, there seems little doubt that the Helen Street refuse power plant will only be the first of several large plants of this type to be installed in this country. —*The Engineer*, (London).



Mechanical laboratory, Rensselaer Polytechnic Institute

International Petroleum Congress Told of Evils of Present Oil Production Methods

Smith Advocates Measures of Restraint all Along the Line from Land to Carburators

THE petroleum industry, present and past, is best described as a frenzy of exploitation. A blind faith that demand will overtake supply, that prices will at least equal costs, that profits will reward perseverance is the only trace of sanity underneath the delirium that is everywhere seen in the hunt for oil, said George Otis Smith, Director of the United States Geological Survey, before the International Petroleum Congress held on Oct. 7 at Tulsa, Oklahoma. Last year our oil wells yielded one-tenth of the oil produced in this country since the beginning and one-sixteenth of the oil yet produced in the world. This flood of oil didn't just happen; on the contrary, the spectacular strikes of new pools were the result of large investments of brains and brawn and cash, nearly 25,000 wells being drilled in that twelve-month period, at a cost of more than half a billion dollars.

Those in the oil business must plan control of this flood or face disaster. Oil is being produced before it is needed and thus production is at a loss. The oil needlessly produced now will not be there to be produced when it is needed.

The economist tells us that petroleum, like the other mineral resources that make up so large a part of America's wealth, is a wasting asset. But we know it is worse than that: it is a wasted asset. Under present methods of production not more than a quarter of the oil in the ground is brought to the surface. It is often less and very rarely more. This measure of waste in production is astounding when we compare oil with almost any other natural product. In mining bituminous coal, for instance, the ratio is reversed: a quarter of the coal is left underground and three-quarters brought to the surface. We speak of oil as labor-cheap; possibly this is true only because we have been too saving of labor and too wasteful of oil.

And the waste does not stop with the oil left in the ground; unfortunately we have acquired spendthrift habits all along the line from the oil in the sands to the gasoline in the carburator. The Bureau of Mines finds an average loss of 6 per cent between the well and the refinery and another loss of 4 per cent at the refinery; and finally consumers of gasoline are so wasteful that they cannot consider themselves without fault. After all, the vital issue in American life may be not the price of gasoline but rather the waste of gasoline and of petroleum. With the consumer, waste is promoted by plenty and cheapness; with the producer, waste comes from haste.

The urge of ever-increasing consumption stimulates the provision of surplus capacity in wells and refineries; then a lively competition among producers leads to an artificial stimulation of demand. Even our laws foster free competition, when what we need is restraint. Public complacency and private initiative, both carried to excess, have conspired to accelerate the rate of speed until we wonder if brakes would work under any condition.

Most of the frenzied haste with which oil wells are put down, regardless of cost or of efficiency or of market conditions, is due to the fugitive nature of ownership in oil and gas. Commonly the drilling program is nothing less than a race to get your neighbor's oil before he gets yours. On such a shaky foundation of tentative as well as temporary title no stable industry can be erected. Just as long as a divided ownership in the oil pool leads the separate owners to exercise the rights and follow the methods of highly competitive and purely individualistic strife in the capture of the oil, just so long will this business be one of haste and waste.

The fact that under the common law the proceeding is not illegal blinds up to the utter lack of equity or of economics in this game of grab. Far too many landowners and oil operators are now missing the profits that are their due, and the general public will later pay its share of the losses in this losing game.

Joint action would weigh the equities of all landowners in an oil pool and, result not only in a fair division of the proceeds but undoubtedly in more oil to be divided. Moreover, by avoiding the haste that wastes oil and disregards market supply the operation would yield the maximum profits.

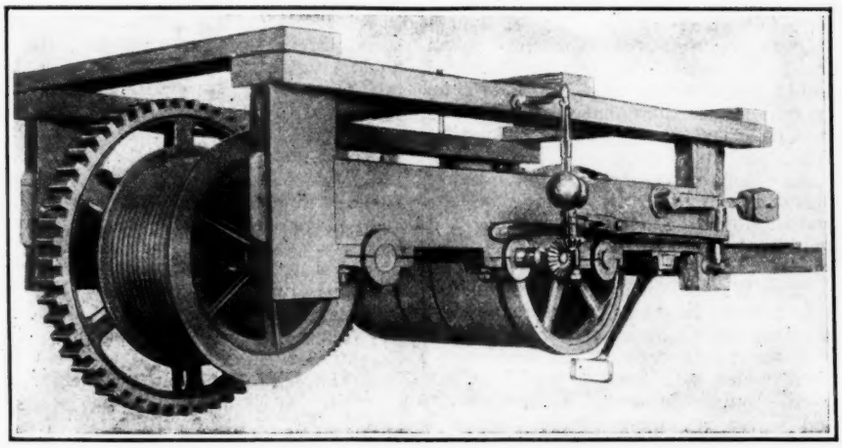
Stokers Sold During August

There were sold during the month of August, 94 stokers of aggregate 419,310 sq.ft. of heating surface served, which were installed under 17 fire-tube boilers of 24,860 sq.ft. of heating surface and 77 water-tube boilers of 394,450 sq.ft. of heating surface.

An Elevator with a Record

Every once in a while someone comes along with the record of a piece of equipment that has given long service. The elevator shown in the illustration has a record of 60 years of service in New York City. It was installed in 1864 by the Otis Elevator Co. and replaced with a modern type machine recently, by the same company.

The old machine was operated by a straight and a cross belt and driven from a power line shaft. In contradistinction to present-day practice of operating the governor from a cable attached to the car, in the old machine the governor is on the elevator machine and operated by beveled gears from one end of an intermediate gear shaft. This governor, instead of operating the safeties on the car, applies a brake to stop the machine in case of overspeeding. One of the outstanding features of the old machine is the large gear on the winding-drum shaft. After 60 years of service it appears to be in about as good condition as when installed.



Elevator machine that has seen sixty years of service

Merrill States Federal Power Commission's Attitude on Public Ownership

Two State and Forty-four Municipal Applications for Power Projects Have Been Made Since Commission Was Created

SINCE THE attitude of the Federal Power Commission toward the development of power by public agencies is coming in for comment in the course of the political discussion over public ownership, O. C. Merrill, the executive secretary of the Commission, has made the following statement in the hope that the basic facts of the Commission's attitude may be understood:

"Since the water power act has been in effect, forty-six applications totalling 2,827,000 hp. have been filed by states and municipalities. The only state applications came from Illinois and cover two projects. The remaining forty-four were sought by municipalities. Seventeen of these projects have been approved. Their total capacity is 411,455 hp. They are located in nine states and in the territory of Alaska.

"In addition to the seventeen projects four other municipal applications are pending, which bring the aggregate up to 675,000 hp. These cover all projects likely to be developed soon.

"Fifteen of the applications were filed by the City of Los Angeles. They involve the installation of 1,660,000 hp. Because of the uncertainty as to the action Congress may take on legislation proposing to give the city rights on the Colorado River, Los Angeles has not been in a position to determine the exact course its municipal development will follow. If rights on the Colorado should be secured undoubtedly some of the developments proposed on the Kern River and in Owens Valley would not be necessary. In view of that situation, the Commission has allowed those applications to remain pending. The Los Angeles applications for rights on Kings River involve lands which are included within the boundaries of a proposed national park. The applications of the city, which have been suspended indefinitely, propose a development of 992,000 hp. or more than ten times the present capacity of the city's plants.

"A water power development proposed by the City of Everett would have interferred with the maximum development of the resources of the stream. An application by the City of Louisville was refused because it would mean the duplication of existing facilities and would require the expenditure of an amount larger than that which the city is authorized to undertake. Another municipal application came from Buffalo, which had to be rejected because the water involved is not under the jurisdiction of the Commission, and would not be until the provisions of the existing treaty are altered.

"The Water Power Act in extending a preference to states or municipalities, requires the Commission to make sure that the plans provide for a development which will 'conserve and utilize in the public interest the navigation and water resources of the region.'" It will be noted that the statute does not provide for the construction or the financing of power developments by the Federal Government. There is a provision for the Commission to recommend any project which should be undertaken by the Federal Government itself. The only action taken under that portion of the law was the recommendation that the development of Great Falls on the Potomac River be undertaken by the United States. The power developments undertaken by the Federal Government, for the most part, have been incidental to some other activity, such as the operation of locks, or the irrigation of lands.

United Electric to Burn Pulverized Fuel

The pulverized-coal installation at the Sherman Creek plant of the United Electric Light and Power Co., New York City, will shortly be put into operation. This installation is of unusual interest inasmuch as it includes several types of multiple and unit systems installed on the same type and size of boiler having equal furnace volume.

The boilers are of the single-cross-drum type of 6,500 sq.ft. of heating surface. They are equipped with 4-in. water-cooling tubes* on two sides of the furnace and a radiant-type superheater forms the major portion of the rear wall, thus presenting a continuous water or steam cooled surface to the radiant heat of the furnace over practically three-quarters of the furnace wall area. The boilers are three-pass with a horizontal baffle located above the second row of tubes and extending about 50 per cent of their length.

The pulverized fuel installation consists of the following equipment, designated by boiler number. No. 4, nine Fuller-Lehigh-horizontal-type burners arranged in three rows of three burners each placed in the front wall, the rows being spaced about 2 ft. on centers. Fuel is supplied to the burners by three triplex feeders of the same make. No. 6, three Quigley burners and feed controllers, the burners being placed in the form of a triangle and spaced approximately 3 ft. on centers. No. 8, Two Arrowwood burners of the multimix type complete with screw feeders furnished by the Sanford Riley Stoker Co. No. 10, The well-type furnace recently developed by the Fuller-Lehigh Co. This consists of a square furnace about 4 ft. on a side and 5 ft. deep placed in the bottom of the combustion chamber. The burners are placed near the bottom of the well and tangentially to the furnace. No. 12, two Raymond Impax units of 5,000 lb. per hour capacity furnished by the Combustion Engineering Corp. No. 14, one simplex unit-type pulverizor of 10,000 lb. per hour capacity, furnished by the Furnace Engineering Co.

The pulverized fuel for the first four boilers is supplied by two 57-in. screen-type Fuller mills. Each mill discharges into a Fuller-Kinyon transport pump which in turn discharges the coal through a common transport line to two weigh bins or to the individual bunkers in front of the boilers.

An additional transport pump is installed below the weigh bins and this discharges the coal to the individual boiler bunkers through the main transport line. For weighing the coal supplied to the two unit-type mills automatic scales are provided overhead.

Power hopes to present in a later issue some of the operating features and results of this installation.

*For detailed description of similar furnaces at Hell Gate Station see page 354 Sept. 2 issue.

To Spend $10,000,000 for Power Equipment

The Railroad Commission of the State of California has recently issued its report for the year ended June 30. It showed a remarkable growth in the public utilities of the state, and that it had authorized the sale of nearly $243,869,746, or about $100,000,000 more securities for utilities than in the previous year.

In California the Railroad Commission's powers are broader than those of public utility commissions of other states and for that reason the report gives an unusually clear picture of the entire developments of these services.

Judging from the expenditures for the past three years of the larger lighting and power companies; the Pacific Gas & Electric Co., Great Western Power Co., San Joaquin Light & Power Corp., and the Southern California Edison Co.; there will be expended this year for hydraulic prime movers, generators and the auxiliary equipment, steam turbines, generators and boilers and auxiliary equipment about $10,000,000 for the year June 30, 1924-25.

Power Shortage in Southern California Relieved

Through the co-operation of the electric consumers of the Southern California Edison Co. during the power shortage in Southern California, the company was able to modify the restrictions on the use of electrical energy on Sept. 8, although ten days later it was found necessary to again restrict the use of industrial power consumers ten per cent. Full use of residential and commercial lighting is now permitted. New business in lighting is being taken on under the usual regulations and power business up to 3-hp. is being taken on without restrictions.

The first unit in the Long Beach steam plant of the Southern California Edison Co. will be in operation by Dec. 1, 1924, after which the power situation will be entirely normal. With the completion of the Florence Lake tunnel, next on the company's Big Creek project, it will be possible to fill Huntington Lake, one of the main storage reservoirs, even with no more precipitation than during the past season, thus lessening the chances of a recurrence of this year's experience.

Personal Mention

Sir William Jones, chairman of the research committee of the British Refractories Association is now visiting the United States.

Prof. J. Stumpf, who is well known as being responsible for the development of the unaflow engine and who has been in this country for the past two months is returning to Germany on the "Columbus" which is sailing from New York on Oct. 18.

Rear Admiral Ralph Earle has been invited to become president of the Worcester Polytechnic Institute by the board of trustees, to succeed Dr. **Ira N. Hollis**, who tendered his resignation 2 years ago to become effective upon the choice of a successor.

Warren C. Bruce, formerly with the Celite Products Co., has accepted a position as chemical engineer and director of research for the Feather-Stone Insulation Co., of Los Angeles. His work will have to do with the study of heat transfer relations and the use of diatomaceous earth for heat insulation.

Society Affairs

The Tri-Cities Section of the A.S.M.E. will hold a banquet on Oct. 20, at which E. St. Elmo Lewis and Robert Wilson will be the speakers.

The Hartford, Conn., Section, A.I.E.E. will hear H. V. Bozell, editor of *Electrical World*, speak on "What the World Power Conference Accomplished," at its Oct. 16 meeting.

The New York Section of the A.I.E.E. will hold a meeting on Oct. 15 at 8 p.m. at 29 West 39th St., New York City. Guy E. Tripp of the Westinghouse Electric and Manufacturing Co. will speak on "Politics and Power," and F. Hodgkinson, Chief Engineer of the Westinghouse company at South Philadelphia, on "Tendencies of Prime Mover Design."

The Carolinas Section, Greenville Branch, of the A.S.M.E. will take a tour of inspection to the Southern Bleachery at Taylors, S. C., Union Bleachery, Greenville, S. C. or Southern Franklin Process Co., Greenville, and the Southern Power Co. at Duncan, S. C. plants on Oct. 24. At 6.30 a dinner meeting will be held at the Greenville Country Club at which George O. Draper, Hopedale Mfg. Co., Milford, Mass., Prof. L. L. Vaughan of the North Carolina State College of Agriculture and Mechanical Arts, William S. Lee, chief engineer of the Southern Power Co., and D. J. Kerr, superintendent of power of the Champion Fibre Co., Canton, N. C., will speak.

Business Notes

Howard Iron Works, Chicago and Granger Sts., Buffalo, N. Y., announces some recent changes in organization: Charles E. Clark was elected president and general manager; C. F. Kneiser, vice-president; Henry J. Turner, general manager for the past year and a half, has resigned; O. E. Frank, who was in charge of heater and expansion joints, has also resigned, and this department will be under the company's chief engineer, E. A. Hahl. These same officers head the Alberger Heater Co., an affiliated company.

Coming Conventions

American Association for the Advancement of Science. Burton E. Livingston, Smithsonian Institution Washington, D. C. Meeting at Washington Dec. 29-Jan. 3, 1925.

American Institute of Chemical Engineers. Dr. John C. Olsen, Polytechnic Institute, Brooklyn, N. Y. Annual meeting at Hotel Schenley, Pittsburgh, Pa., Dec. 3-6.

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Fall convention at Pasadena, Calif., Oct. 13-17.

American Institute of Mining and Metallurgical Engineers. F. F. Sharpless, 29 West 39th St., New York City. Autumn meeting at Birmingham, Ala., Oct. 13-15.

American Society of Civil Engineers. 29 West 39th St., New York City. Fall meeting at Hotel Fuller, Detroit, Oct. 23-25.

American Society of Mechanical Engineers. Calvin W. Rice, 29 West 39th St., New York City. Annual meeting at New York City, Dec. 1-4.

American Society of Refrigerating Engineers. W. H. Ross, 35 Warren St., New York City. Annual meeting at New York City, Dec. 1-3.

American Welding Society. Miss M. M. Kelly, 29 West 39th St., New York City. Convention in Cleveland, Hotel Winton, Oct. 30-31.

Eastern Ice Manufacturers Association. W. H. Ross, 35 Warren St., New York City. Eighteenth annual meeting at Hotel Chelsea, Atlantic City, N. J., Nov. 12-14.

Electrical Exposition. Lincoln Bancroft, 124 West 42nd St., New York City. Exposition will be held at the Grand Central Palace, New York City, Oct. 15-25.

Electric Power Club. S. N. Clarkson, B. F. Keith Bldg., Cleveland, Ohio. Fall meeting at Greenbriar, White Sulphur Springs, W. Va., Oct. 20-23.

Engineering Institute of Canada. Fraser S. Keith, 176 Mansfield St., Montreal, Que. Annual meeting at Montreal, Que., Jan. 27-29.

Exposition of Inventions. E. W. Bartlett, 47 West 34th St., New York City. Exposition at Engineering Societies Building, 29 West 39th St., New York City, Dec. 8-13.

Illuminating Engineering Society. Norman D. MacDonald, 29 West 39th St., New York City. Convention at Briarcliff Lodge, Briarcliff Manor, N. Y., Oct. 27-31.

National Association of Practical Refrigerating Engineers. E. H. Fox, 5707 West Lake St., Chicago, Ill. Convention at New Orleans, La., Nov. 11-14. Exhibits at the Isaac Delgado High School.

National Exposition of Power and Mechanical Engineering. C. F. Roth, Grand Central Palace, New York City. Annual exposition at New York City, Grand Central Palace, Dec. 1-6.

Society of Automotive Engineers. C. F. Clarkson, 29 West 39th St., New York City. Annual meeting at Detroit, Mich., Jan. 20-23.

Society of Naval Architects and Marine Engineers. Daniel H. Cox, 29 West 39th St., New York City. Annual meeting at 29 West 39th St., New York City, Nov. 13-14.

Trade Catalogs

Insulation — The Philip Carey Co., Lockland, Cincinnati, Ohio, has recently reprinted from *Mechanical Engineering* a paper "Heat Losses Through Insulating Materials, a Rational Method for Their Determination by Means of the Conductivity Coefficients of the Material," by R. H. Heilman.

Couplings, Flexible—Foote Bros. Gear & Machine Co., 213-221 North Curtis St., Chicago, Ill. Bulletin IXL contains descriptions of flexible couplings: Foote IXL, pin type, semi-universal, Francke flexible, Grundy, Ajax. The bulletin is well illustrated and includes tables of dimensions and prices.

Gates, Hydraulic Regulating—Whiting Corp., Harvey, Ill. The leaflet describing these special forms of gates for controlling the flow of water and operating and hoisting machinery is illustrated with pictures of interesting installations which this company has erected and gives figures on sizes and capacities.

Fuel Prices

BITUMINOUS COAL

The following table shows the trend of the spot steam market in various coals (mine run bases, f.o.b. mines):

Coal	Market Quoting	Sept. 22, 1924	Oct. 6, 1924
Pool 1	New York	$3.00	$3.00
Smokeless	Columbus	2.25	2.35
Clearfield	Boston	2.35	2.35
Somerset	Boston	2.50	2.40
Kanawha	Columbus	1.55	1.55
Hocking	Columbus	1.75	1.75
Pittsburgh No. 8	Cleveland	1.90	1.90
Franklin, Ill.	Chicago	2.50	2.50
Central, Ill.	Chicago	2.25	2.25
Ind. 4th Vein	Chicago	2.50	2.50
West Ky.	Louisville	1.80	1.90
S. E. Ky.	Louisville	1.75	1.90
Big Seam	Birmingham	1.75	1.75

FUEL OIL

New York—Oct. 8, light oil, tank-car lots; 28@34 deg. Baumé, 4¾c. per gal.; 36@40 deg. 5c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Sept. 23, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.75 per bbl.; 26@28 deg., $1.80 per bbl.; 28@30 deg., $1.85 per bbl.; 30@32 deg., $1.90 per bbl.; 32@36 deg., gas oil, 5.5c. per gal.; 38@40 deg., 6c. per gal.

Pittsburgh—Sept. 30, f.o.b. local refinery; 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., fuel oil, 5¼c. per gal.

Dallas—Oct. 2, f.o.b. local refinery, 26@30 deg., $1.15 per bbl.

Philadelphia—Oct. 2, 28@30 deg., $1.99½@$2.06 per bbl.; 18@22 deg., $1.87½@$1.93¾; 13@16 deg., $1.75@$1.81½ per bbl.

Boston—Oct. 4, tank-car lots, f.o.b.; heavy oil, 12@14 deg. Baumé, 4¼c. per gal.; light oil, 28@32 deg. Baumé, 5¼c. per gal.

Cincinnati—Oct. 6, tank-car lots f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5¼c. per gal.; 30@32 deg., 5½c. per gal.

Chicago—Sept. 29, 20@22 deg., 5¼c. per gal.; 24@26 deg., 6c. per gal.; 28@30 deg., 6c. per gal.

New Plant Construction

Ala., Pratt City (Branch of Ensley)—The Birmingham Electric Co., Birmingham, plans extensions and improvements to its plant here, estimated cost about $50,000.

Ariz., Charleston—San Pedro Valley Irrigation Co., Tombstone, plans an election for a bond issue (to exceed $25,000) to be used for a dam across San Pedro River at Charleston. W. R. Elliott, Phoenix, is engineer.

Calif., Del Monte—Del Monte Properties Co., 620 Market St., San Francisco, plans to rebuild hotel destroyed by fire, estimated cost $1,000,000. Architect not selected.

Calif., Helm—Stinson Irrigation Dist., R. M. Bostwick, Secy., 422 Mattei Bldg., Fresno, is receiving bids until Oct. 21 for materials, motors, pumps, etc., in connection with irrigation system. Project will include 2 vertical shaft induction motors, 60 cycle 1,200 r.p.m. 3 phase, 40 degrees temperature rise, with starting compensator, equipped with no voltage and overload relays, also automatic time delay device. Motor designed for conduit wiring. Bids on 20 and 25 hp. required. Performance curves or tables of motors should be submitted with the bids; 2 deep well turbine pumps to be installed in 14 in. stove pipe casing. Pumps to have 60 ft. of column, 20 ft. of suction, to pump from 2 to 3 sec. ft. against a total lift of from 35 to 55 ft. These pumps will be direct connected to vertical shaft motor 1200 r.p.m. Also quote price for additional discharge pipe. Performance curves of pump are required with proposal; 2 deep well turbine pumps in wells from derricks already erected in pump houses. Also making necessary pipe connections from pump to ditch; 2 motors on 2 deep well pumps, wiring same and equipment. Price quoted to include all necessary material for wiring and also for building panel. (Similar installations may be seen on the district.) Quinton, Code & Hill, Hollingsworth Bldg., Los Angeles, are engineers.

Calif., Los Angeles—The Supervisors of Los Angeles County, H. E. Lampton, Clk., will receive bids until Oct. 20 for the construction of a refrigerating and ice making plant for County Sanitarium.

Calif., San Francisco—H. C. Smith, architect, Humboldt Bank Bldg., is preparing plans for the construction of a 12 story apartment house at Jackson and Steiner Sts., for a corporation now being organized, estimated cost $550,000.

Calif., Sierra City—R. Gillespie, engineer, is having plans prepared for power development on South Fork of North Fork of Yuba River, involving 2,000 ft. ditch extension, $6,000; penstock, $1,000; power house with water wheel and generator, $8,000; pole line and wire for 2½ miles, $3,500.

Calif., Tracy—Banta-Carbona Irrigation Dist. is in the market for pumps, motors and valves. Bids were received on this equipment and rejected. W. D. Harrington is chief engineer.

Conn., Norwalk—New Haven Dairy Co., 201 Hazel St., New Haven, plans to remodel present building and to construct an addition to ice plant on Knight St., here, estimated cost $40,000.

D. C., Washington—E. K. Fox, 1313 H St. N.W., awarded the contract for the construction of an apartment house at 21st and Pennsylvania Ave. N.W., estimated cost $1,000,000.

Ia., Hawarden—The City, F. A. Gefke, Clk., awarded the contract for the construction of an electric light and power plant, oil engine, switchboard, etc.

Me., Wilton—Wilton Woolen Co. awarded the contract for the construction of a hydro-electric plant, estimated cost $40,000.

Mass., Boston—Massachusetts Grand Lodge I. O. O. F., G. H. Fuller, Secy., plans the construction of a temple, estimated cost $1,000,000.

Mass., Salem—H. Kaplan, 36 Webb St., plans the construction of an elevated coal pocket, capacity 750 tons, estimated cost $50,000.

Mich., Detroit—Wayne County Road Commission, Real Estate Exchange Bldg., will soon award contract for furnishing labor and material for substructure, drainage system, pumphouse, well, lighting and floor slab for grade separation project; also installation of lighting equipment including conduits, switches, wiring, lamps, etc.

Minn., Granite Falls—The City will receive bids until Oct. 23 for a filtration plant, including one 500 g.p.m. pump and motor, one 1,000 g.p.m. pump and motor, one 300 and 150 g.p.m. pumps and motors, direct connected; complete equipment for 2 filter units, etc., in connection with water works system.

Minn. Owatonna—Utilities Commission, M. R. Cashman, Chn., awarded the contract for the construction of a heating system in a building 64 x 90 ft. with 160 ft. smoke stack.

Mo., Aurora—Lawrence County Water, Light & Cold Storage Co., will soon receive bids for a steam generating plant of 500 kw.

Mo., Clinton—The City is having plans prepared for the construction of a power plant. E. T. Archer & Co., 609 New England Bldg., Kansas City, are engineers.

Mo., Elsberry—Lincoln Rice Farming Co., c/o A. V. Rowe, plans the construction of an irrigation system to include 30,000 acres, main channel to be 7 mi. long and 60 to 75 ft. wide, with numerous laterals; 3 pumping suits of 10,000 g.p.m., each unit to have 100 hp. engine with dynamos, generators, etc., for lighting purposes.

Mo., Hartville—The City will build a 260 ft. masonry and concrete, dam, 13 ft. high, 1 story, 20 x 24 ft. power house, and install 42 kva. water wheel, 3 phase, 60 cycle 2,300 v. alternator, 25 hp. coal oil engine belted to 25 kva. alternator, switchboard, etc. Alexander Engineering Co., 517 Woodruff Bldg., Springfield, is engineer.

Mo., St. Louis—Southwestern Bell Telephone Co., Broadway and Locust St., will soon award contract for the construction of a 28 story office and exchange building at Pine, 10th, Chestnut and 11th Sts., estimated cost with equipment $8,000,000. Knight Engineering Co., Wainwright Bldg., is engineer. Mauran, Russell & Crowell, Chemical Bldg., are architects.

N. H., Portsmouth—Twin State Gas & Electric Co., 160 State St., Boston, Mass., plans the construction of a power house, estimated cost $40,000. Private plans.

N. Y., New York—Presbyterian Hospital, Madison Ave. and 70th St., plans to construct a group of hospital buildings at Broadway and 168th St., estimated cost $10,000,000. Architect not selected.

N. Y., New York—D. J. Rubenstein, c/o Goldner & Goldner, architects, 47 West 42nd St., will build a 15 story apartment house at 209 West 106th St., estimated cost $800,000.

O., Cincinnati—Hotel Alms Co., McMillan and Alms Pl., awarded the contract for the construction of a 11 story hotel on Locust St., estimated cost $1,000,000.

O., Newton Falls—Village of Newton Falls is having plans prepared for deep well pump, high service pump, 2,500 g.p.m. pump, pump towers, etc., estimated cost $40,000. G. B. Gascoigne, Leader-News Bldg., Cleveland, is engineer.

O., Portsmouth—United States Laundry Co., 40th St., awarded the contract for the construction of a 2 story, 60 x 65 ft. laundry building.

Okla., Catoosa—The City voted $20,000 bonds for the construction of a new water-works system, securing water from the Spavinaw pipe line which supplies Tulsa. Project will include centrifugal pump, tank and tower. Holway Engineering Co., New Wright Bldg., Tulsa, is engineer.

Ore., Portland—Jenson & Van Herberg plan the construction of an 8 to 10 story theatre and office building at Broadway, Salmon, Park and Main Sts., estimated cost $2,000,000. Bennus & Herzog, Chamber of Commerce Bldg., are architects.

Tex., Jayton—The City will soon hold bond election for the construction of a water-works system, including tank, tower and 4 mi. of 6 in. pipe from present reservoir, estimated cost $50,000. Montgomery & Ward, 1016 City National Bank Bldg., Wichita Falls, are engineers.

Tex., New Braunfels—San Antonio Public Service Co., 201 North St. Mary's St., San Antonio, E. F. Kifer, Vice Pres. & Mgr., plans the construction of a power plant on the Guadalupe River near New Braunfels, estimated cost $3,000,000.

Tex., Pt. Arthur—The City voted $48,000 bonds for improvements to water-works system, including mains, laterals and large power house with some pumping equipment.

Va., Roanoke—New Hotel Corp., W. W. Boxley, Pres., Boxley Bldg., will receive bids until Oct. 23 for the construction of an 11 story hotel on Jefferson St., estimated cost $900,000. D. Gutman, 221 West 57th St., New York, is engineer. W. L. Stoddart, 50 East 41st St., New York, is architect.

Wash., Bellingham—The City plans to vote on a $150,000 bond issue to be used for the extension of the water system to Lake Campbell, also to install a pumping plant, using Whistle Lake as storage reservoir. W. B. Short, city engineer.

Wash., Wenatchee—G. Nelson, Seattle, has secured the contract for the construction of the Riverside Irrigation Dist. project, which will put under water 4,020 acres on the shores of the Okanogan River. The contract provides for a dam 23½ ft. high and 150 ft. long on the Okanogan River, 7 mi. from Riverside. The power house will be equipped with 3 turbines of 950 hp. each. A transmission line 15 miles long will be built. The district is bonded for $450,000.

Wis., Black River Falls—The City will soon award contract for the construction of a dam and filtration gallery, including pumping equipment.

Wis., Madison—The Oscar Mayer Co., A. C. Bolz, Mgr., plans to purchase refrigeration machinery, artificial ice making machine, etc., for new cold storage plant. Gardner & Lindberg, South Dearborn St., Chicago, Ill., are engineers.

Wis., Platteville—Interstate Power Co., E. J. Smith, Mgr., plans an addition to power system and extension of transmission line, estimated cost $40,000. Engineer not selected.

Ont., Ansonville—The Village plans the construction of a water-works system, including mains, hydrants, valves, electric pumps and filters, estimated cost $30,000 to $50,000. James, Proctor & Redfern, 36 Toronto St., Toronto, are engineers.

Ont., Brantford—Hydro Electric Commission plans to purchase and install transformer in substation, about 1,000 kva.

Ont., Harrow—Colchester South Township Council, J. H. Madill, Harrow, Clk., plans to secure estimates from Ontario Hydro Commission, Sir Adam Beck, London, Ont., Chn., for power system to supply residents of the township of Harrow and the Lake Front with light and power.

Ont., Kapuskasing—Spruce Falls Pulp & Paper Co. plans to develop hydro-electric plant and construct pulp mill. Project includes power plant located at Smoky Falls on the Mattagami River, 80 ft. head, 50,000 hp., including dams, pumps, turbines, generators, transformers, switches, motors, etc. Estimated cost between $5,000,000 and $8,000,000.

Ont., Kingston—Hydro Electric Power Commission, 190 University Ave., Toronto, is having plans prepared for the installation of a hydro-electric generating plant at Jones Falls on the Rideau River, 65 ft. head, 2,500 hp., estimated cost $500,000. F. A. Gaby, University Ave., Toronto, is chief engineer.

Ont., Sarnia—Sarnia Hydro System plans the construction of a 26,000 volt substation, including slip down and service transformers, switching equipment, disconnecting switches, oil switches and lightning arresters.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are prices to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

A month ago advances were in excess of declines in the market for power-plant and electrical supplies. The current market, however, shows all price changes to be downward. The seven outstanding declines were in the following materials: rubber-covered copper wire, armored cable, cold-drawn steel, silica brick, babbitt metal, linseed oil and wiping cloths.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, sing'e jacket		56c. per ft.
Common, 2½-in., 3-ply	80c. per ft. list less	50–10%

	Air—Best grade			
¾-in., per ft.	3-ply	$0 36	4 ply	$0.44½

	Steam—Discounts from List			
First grade	30–5%	Second grade	40–5%	Third grade 50%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade 50% Second grade 50–10%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses.

Grade	Discount from list
Medium	40–2½%
Heavy	30–5%

RAWHIDE LACING—For cut, best grade, 45–5%, 2nd grade, 55%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 45–5%; sides, 41c. per sq.ft.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ⅛ in	$0.90
Asbestos for high-pressure steam, ½ in.	1.70
Duck and rubber for piston packing	.90
Flax, regular	1.10
Flax, waterproofed	1.70
Compressed asbestos sheet	.80
Wire insertion asbestos sheet	1.30
Rubber sheet	.45
Rubber sheet, wire insertion	.70
Rubber sheet, duck insertion	.50
Rubber sheet, cloth insertion	.25
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.30
Asbestos wick, ½- and 1-lb. balls	50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
For low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.50@ $2.60 per bbl. without bags, in carload lots delivered on job. Bag charge of 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, 3 to 15-in. beams and channels and 3 to 6-in. angles, tees, and plates, all $3.34 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	14@21	19.00	14.00
Colored	9@14.50	18.00	10.50

WIPING CLOTHS—Jobbers' prices, in cents per lb., as follows:

	13½ x 13½	13½ x 20½
Chicago	16.00	16.00
New York (white, at washeries)	11 25	...
Cleveland	$36.00 per M.	$50.00 per M.

LINSEED OIL—These prices are per gallon:

	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$1.03	$1.16	$1.05

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	14.75	14.00	16.25	15.50
White	14.75	14.00	14.75	14.00

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	50%	60–10%	70%
Tinned	50%	60–10%	70%

Structural rivets, ½, ⅝, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.

New York $3.75 Chicago $3.50 Pittsburgh $2.60

Boiler rivets, same sizes:

New York $3.85 Chicago $3.60 Pittsburgh $2.90

REFRACTORIES—Prices in car lots f.o.b. plant:

Chrome brick, eastern shipping points	net ton	$47@52
Chrome cement, 40@ 50% Cr_2O_3, in bulk	net ton	22@27
Chrome cement, 40@ 50% Cr_2O_3, in sacks	net ton	26@31
Magnesite brick: 9-in. straights	net ton	65@68
Magnesite brick: 9-in. arches, wedges and keys	net ton	71.50@74.80
Magnesite brick: Soaps and spits	per ton	91.00@95.20
Silica brick: Mt. Union, Pa.	per M	33@35
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	40@47
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	40@43
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	42@43
Clay brick, 2nd quality, 9 in. shapes, Pennsylvana	per M	35@42
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	37@39
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	37@39
Chrome ore crude, 40@50%	net ton	17.00@19.50

BABBITT METAL—Warehouse prices in cents per pound:

	New York	Cleveland	Chicago
(83% tin)	60.00	57.00	48@52
(35% tin)	28.00	18.50	23@26

COLD DRAWN STEEL—Warehouse prices are as follows:

	New York	Cleveland	Chicago
Round shafting and screw stock, per 100 lb. base	$4.05	$3.90	$3.80
Flats, squares and hexagons, per 100 lb. base	4.55	4.40	4.30

BOILER SPECIALTIES—F. o. b. New York or Jersey City, discounts on list:

	Current
Copper ferrules	70%
Boiler flanges	60-10%
Boiler stay bolts	60%
Boiler patch bolts	10%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%
Pressed steel boiler hangers	10%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1⅛	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are prices in New York warehouse of tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$0.23
1¼	.....	.....	.25
1½	.....	.....	.22
1¾	$0.26	$0.29	.23
2	.20	.25	.21
2¼	.23	.29	.23
2½	.24	.33	.28
2¾	.....	.....	.....
3	.30	.41	.32
3¼	.32	.47	.35
3½	.34	.51	.37
4	.43	.64	.47

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.

These prices are net per lineal foot based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

1½ in. to 2 in. diameter, 5c. per cut. 2¼ in. diameter, 7c. per cut
2½ in. diameter, 6c. per cut. 3 in. diameter, 9c. per cut
3½ in. to 4 in. diameter, 10c.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft
No. 14 solid	$40.00 (net)	$ 56.50 (net)	$164.00	$210 00
No. 12 solid	135.00	170.00	225.00	265 00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	285.00	375.00	520.00	500.00
No. 6 stranded	400.00	500.00	560.00	.....

From the above lists discounts are:		Lead Covered
Less than coil lots	45%	25%
Coils to 1,000 ft.	50%	30%
1,000 to 5,000 ft.	55%	35%
5,000 ft. and over	60%	40%

CONDUIT, Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, Per 100 pieces, f.o.b. New York, with 10-day discount of 5 per cent.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$61.10	$66.16	$9.90	$11.03	$5.74	$6.16
⅜	79.20	84.95	13.00	14.49	8.18	8.78
1	112.06	122.19	19.26	21.46	10.65	11.42
1¼	151.62	165.31	25.65	28.33	14.76	15.78
1½	181.28	197.67	34.19	37.77	18.23	19.47
2	248.90	265.94	62.70	69.24	24.29	25.97
2½	385.50	420.48	102.58	111.33	34.71	37.10
3	504.29	548.81	273.40	302.12	51.66	55.63
3½	633.86	688.65	604.03	667.15	69.41	74.19
4	772.62	838.59	697.06	770.99	86.76	92.73

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices each in standard-package quantities:

CUT-OUTS, PLUG

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy	$21.00
No. 16 cotton reinforced heavy	24.00
No. 18 cotton reinforced light	17.00
No. 16 cotton reinforced light	20.50
No. 18 cotton Canvasite cord	16.50
No. 16 cotton Canvasite cord	18.75

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.15	3-amp. to 30-amp.	100	$0.30
35-amp. to 60-amp.	100	.30	35-amp. to 60-amp.	100	.60
61-amp. to 100-amp.	50	.90	65-amp. to 100-amp.	50	1.50
101-amp. to 200-amp.	25	2.00	110-amp. to 200-amp.	25	2.50
201-amp. to 400-amp.	25	3.60	225-amp. to 400-amp.	25	5.50
401-amp. to 600-amp.	10	5.50	450-amp. to 600-amp.	10	8.00

Discount: Less 1-5th standard package, 55%; 1-5th to standard package, 60%; standard package, 65%.

RENEWABLE FUSES, ENCLOSED—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0 50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4 00	5.00	25	5
225 to 400-amp.	7.50	11 00	25	1
450 to 600-amp.	11.00	16.00	10	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30	$0.30 ea.	$0.05	100	100
35 to 60	.05 ea.	.06	100	100
65 to 100	.10 ea.	.10	50	50
110 to 200	.15 ea.	.15	25	50
225 to 400	.30 ea.	.30	25	25
450 to 600	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than std. pkg.	22%
Std. pkg.	40%
Discount Without Contract—Renewals:	
Less than std. pkg.	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.85
0-30 ampere, less than standard package	3.15

LAMPS—Below are present quotations in less than standard package quantities:

Straight-Side Bulbs Mazda B— Watts	Plain	Frosted	No. in Package	Pear-Shaped Bulbs or Bowl Enameled Mazda C— Watts	Clear	Frosted	No. in Package
10	$0.27	$0.32	120	50	$0.40	$0.45	60
15	.27	.32	120	75	.45	.55	60
25	.27	.32	120	100	.55	.60	24
40	.27	.32	120	150	.70	.75	24
50	.27	.32	120	200	.95	1.05	24
60	.32	.37	120	300	1 50	1 60	24
				500	2 25	2.40	12
				750	3.75	3.95	8
				1.000	4.00	4.25	8

Standard quantities are subject to discount of 10% from list. Annual contracts ranging from $75.00 to $300,000 net allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain separable attachment plug	$0.18
Composition 2-piece attachment plug	.27
Swivel attachment plug	.12
Small size—2 Pc. Plug—Composition	.08½

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York,

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Duplex
14	$6.70	$8.60	$10.40	$16.75
12	8.90	11.50	13 00	21 00
10	11.20	14.95	16.50	28.50
8	16.50	19.85	22 05	38.50
6	.....	.....	31 25	.....
4	.....	.....	42 50	.....
2	.....	.....	62 25	.....
1	.....	.....	80.53	.....
0	.....	.....	108.50	.....
00	.....	.....	128.50	.....
000	.....	.....	153.00	.....
0000	.....	.....	184.50	.....

SOCKETS, BRASS SHELL—

½ In. or Pendant Cap Key Each	Keyless Each	Pull Each	¾ In. Cap Key Each	Keyless Each	Pull Each
$0.33	$0.30	$0 55	$0.39	$0.36	$0.61

Less 1-5th standard package	25%
1-5th to standard package	32%
Standard package	37%

WIRING SUPPLIES—

Friction tape, ¾ in., less 100 lb. 34c. lb., 100 lb. lots	33c. lb.
Rubber tape, ¾ in., less 100 lb. 34c. lb., 100 lb. lots	33c. lb.
Wire solder, less 100 lb. 27c. lb., 100 lb. lots	29c. lb.
Soldering paste, 2 oz. cans	$1.00 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole, Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25 to $50 list value	30–5%
$50 list value or over	35%